

FINAL

SYSTEMS OPERATION AND OPTIMIZATION TEST REPORT

**INTERIM MEASURE/INTERIM
REMEDIAL ACTION FOR THE
881 HILLSIDE OPERABLE UNIT 1**

ROCKY FLATS PLANT

**U S DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado**

ENVIRONMENTAL RESTORATION PROGRAM

November 1992



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Economists
Scientists

November 20 1992

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Dear Mr Burmeister

Subject 881 Hillside OU 1 Final Systems
Operation and Optimization Test Report

Enclosed are 12 copies of the Systems Operation and Optimization Test Report The review comments have been addressed and incorporated into the report

Please let us know if you have any questions

Sincerely

CH2M HILL

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100127AB DEN

Enclosures

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REVIEWED FOR CLASSIFICATION/UCNI

By
Date 10/5/92

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LIST OF ACRONYMS

The following is a list of acronyms used throughout this report

Al	aluminum
ARARs	applicable or relevant and appropriate requirements
As	arsenic
AWQC	Ambient Water Quality Criteria
Ba	barium
Be	beryllium
CCR	Colorado Code of Regulations
Cd	cadmium
CDH	Colorado Department of Health
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
Cr	chromium
CWA	Clean Water Act
DOE	Department of Energy
EPA	Environmental Protection Agency
ESI	Engineering Service Inc
Fe	iron
FS	feasibility study
gpm	gallons per minute
Hg	mercury
IAG	Inter Agency Agreement
IHSS	Industrial Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IX	ion exchange
l or L	liter
MCC	motor control center
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
mg/l or mg/L	milligrams per liter
ml or mL	milliliter
Mn	manganese
MSDS	Material Safety Data Sheets
Ni	nickel
O&M	operations and maintenance
OU	operable unit
Pb	lead
pCi/g	picocuries per gram
pCi/l or pCi/L	picocuries per liter
PLC	programmable logic controller
ppb	parts per billion
ppm	parts per million

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Pu	plutonium
PVC	polyvinyl chloride
QC	Quality Control
Ra	radium
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RFP	Rocky Flats Plant
RI	remedial investigation
Sb	Antimony
SDWA	Safe Drinking Water Act
Se	selenium
SID	South Interceptor Ditch
SOP	Standard Operating Procedure
TBC	to-be-considered
TDS	total dissolved solids
U	uranium (unless otherwise noted)
ug/L or $\mu\text{g/L}$	micrograms per liter
UV/H ₂ O ₂	ultraviolet hydrogen peroxide
VOA	volatile organic analysis
VOC	volatile organic compound
WQC	Water Quality Criteria
WQCC	Water Quality Control Commission

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TITLE Introduction

Approved By

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11 / 20 / 92
(Date)

1 0 INTRODUCTION

A groundwater collection and treatment facility was constructed as part of an Interim Measure/ Interim Remedial Action (IM/IRA) at the 881 Hillside site (Operable Unit [OU] No 1) at the Rocky Flats Plant (RFP). The groundwater at this site is contaminated with low levels of chlorinated solvents, heavy metals, and radionuclides.

This report describes the system operation and optimization testing conducted during the startup and initial operation of this facility. System operation testing was conducted as described in Appendix D of the Work Plan Manual for the Startup, Operation, and Maintenance of the Interim Measure/Interim Remedial Action for the 881 Hillside Operable Unit No 1 (EG&G February 1992). Additional optimization testing of the treatment systems was also conducted as the startup and operation progressed. The purpose of systems operation testing was to determine whether individual components operated separately and together as designed, whereas the optimization testing evaluated the operation and performance of the system under varying conditions. This report includes the results of both systems operation and optimization. It contains a description of the tests and their purpose, and presents the test results with the data summary. It also provides recommendations for treatment system improvements and modifications as determined necessary during testing and process optimization.

1 1 SITE DESCRIPTION

The RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver. The Plant site consists of approximately 6,550 acres of federally owned land in Sections 1 through 4 and 9 through 15 of T2S R70W 6th principal meridian. Major buildings are located within an area of approximately 400 acres known as RFP security area. The security area is surrounded by a buffer zone of approximately 6,150 acres (DOE 1990).

The RFP is a government-owned contractor-operated facility. It is a part of a nationwide nuclear weapons research, development, and production complex administered by the Albuquerque Operations Office of the U.S. Department of Energy (DOE). The operating contractor for the Rocky Flats Plant is EG&G Rocky Flats. The facility manufactured components for nuclear weapons and has been in operation since 1951. RFP fabricates components from plutonium, uranium, beryllium, and stainless steel. Production activities include metal fabrication, machining, and assembly. Both radioactive and nonradioactive wastes are generated in the process. Current waste handling practices involve onsite and offsite recycling of hazardous materials and offsite disposal of solid radioactive materials at other DOE facilities (DOE 1990).

This section provides background on the RFP site, specifically the 881 Hillside OU 1. Information is also provided on the contaminants of concern that have resulted in the DOE decision to undertake an IM/IRA at OU 1.

The 881 Hillside Area is located at the southeast corner of the RFP (see Figure 1.1). Based on the past operations knowledge, 12 distinct sites, or Resource Conservation and Recovery Act (RCRA) Industrial Hazardous Substance Sites (IHSSs), have been identified as the components of the 881 Hillside area. These IHSSs have contributed volatile organic constituents, metals, and radionuclides to the groundwater in the area. Furthermore, the sites are in the proximity of a surface drainage, Woman Creek. The creek routes surface water into Mower Reservoir and Standley Lake, located due southeast of the RFP. Water from these bodies is used for direct or indirect human consumption. Because of a potential for impact on human health, the 881 Hillside IHSSs were designated by DOE as high priority sites for the IM/IRA.

A brief description of each IHSS follows. Figure 1.1 also indicates relative locations of the IHSSs.

1. **Oil Sludge Pit (IHSS 102)**—A small pond located south of Building 881 was used for disposing of oil sludges in the late 1950s.

- 2 **Chemical Burial Site (IHSS 103)**—A small pit was used for disposal of liquid wastes south-east of Building 881 in the early 1960s
- 3 **Liquid Dumping (IHSS 104)**—An area east of Building 881 was reportedly used for disposing of unknown liquids before 1969. However, because the results of area drilling in 1987 did not substantiate this disposal, the site probably does not exist, and its location is not shown on the map.
- 4 5 **No. 6 Fuel Oil Tanks (IHSSs 105.1 and 105.2)**—Two fuel oil tanks are located south of Building 881. They are out of service and filled with concrete.
- 6 **Outfall Site (IHSS 106)**—An overflow line from the sanitary sewer sump south of Building 881 daylights on the slope below the building.
- 7 **Hillside Oil Leak (IHSS 107)**—Oil was discovered flowing from the Building 881 footing drain in early 1973. Although the source of oil was never positively identified, the oil was collected in a skimming pond and transported offsite. Discharge of water from the footing drain is ongoing.
- 8 9 **Multiple Solvent Spills (IHSS 119.1 and 119.2)**—Two areas east of Building 881 were used for barrel storage between 1969 and 1972.
- 10 **Radioactive Site (IHSS 130)**—Soils contaminated with low levels of radionuclides were placed on the hillside east of Building 881 and covered with soil between 1969 and 1972.
- 11 **Sanitary Sewer Line Leak (IHSS 145)**—The sanitary sewer line leaked on the hillside southwest of Building 881 in early 1981.
- 12 **Drum Storage Area (IHSS 177)**—Building 885 is currently used for satellite collection and 90-day accumulation of RCRA regulated wastes. The building will be closed, and soil

remediation will be addressed under RCRA Interim Status (6 Colorado Code of Regulations [CCR] 1007-3) Groundwater contamination will be addressed as part of the 881 Hillside Area remedial investigation/feasibility study (RI/FS) performed under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA)

The IM/IRA at OU 1 consists of treating the groundwater from the 881 Hillside area for the removal of chlorinated volatile organic chemicals heavy metals dissolved solids, and selected radionuclides

1 2 WASTE STREAM DESCRIPTION

The groundwater from the 881 Hillside area is collected from three locations

- 1 The Building 881 footing drain
- 2 A new recovery well installed southeast of Building 891 represents the 881 Hillside wells that are the most contaminated The recovery well is designated as CW001
- 3 A new french drain installed parallel to and near the bottom of the slope collects the 881 Hillside alluvial water that is beyond the current contamination plume The water from the french drain represents the downgradient wells.

The footing drain was characterized by low concentrations of VOCs and of a few metals major ions and uranium above estimated background concentrations Of the VOCs only tetrachloroethene (PCE) exceeded applicable or relevant and appropriate requirements (ARARs) in 1989 Average values for total dissolved solids (TDS) and mercury exceeded ARARs for the inorganic constituents however the high average mercury concentration is considered an artifact of including an apparent erroneous data point (0.9 µg/l) Subsequent analyses show mercury concentrations to be below ARARs The dissolved plutonium concentration is also considered an erroneous data point because the total plutonium concentration for that sample was less than the minimum detectable activity (MDA)

Groundwater at the 881 Hillside Area is characterized by significant VOC contamination. High concentrations of VOCs are notably present in the vicinity of Solid Waste Management Unit (SWMU) 119.1 at well 9-74. The maximum concentration for most of the metals exceed estimated groundwater background concentrations and ARARs. However, the average values for manganese and selenium exceeded the ARARs. Total dissolved solids, chloride, nitrate-nitrite, and sulfate have average values that exceed ARARs. Average dissolved strontium and uranium concentrations exceed background, but not ARARs.

Downgradient of the 881 Hillside Area, the groundwater chemistry is characterized by the absence of VOC contamination, with the exception of low concentrations of methylene chloride, acetone, and tetrachloroethene. The methylene chloride and acetone are suspected laboratory contaminants because of their presence in laboratory blanks. The tetrachloroethene was detected only in the first quarter 1989 in wells 64-86 and 2-87 at estimated concentrations below detection limits, and was not detected in these wells during second quarter 1989. Average concentrations of several metals, major ions, and strontium (89 + 90) and uranium are above the estimated background for groundwater. Concentrations of these inorganic constituents are somewhat lower than at the 881 Hillside Area, and nitrate, chloride, and sulfate do not exceed ARAR on the average. Inorganic constituents have apparently migrated from the 881 Hillside Area, but organic contaminants have not migrated to any appreciable extent. There was only one occurrence of plutonium at a concentration above the MDA. This occurred in well 2-87. Of the six plutonium concentrations measured at well 2-87, all except this one were below the MDA (DOE 1990).

1.3 TREATMENT GOALS/ARARS

This section presents a summary of the potential ARARs associated with the 881 Hillside groundwater. At this time, the treatment goals for the IM/IRA are the potential ARARs. The potential

ARARs or to-be-considered (TBC) requirements are based on contaminants detected in the 881 Hillside area samples and the following current federal and state health and environmental statutes and regulations

Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs)

Clean Water Act (CWA) water quality criteria (WQC)

RCRA Subpart F Groundwater Concentration Limits (40 CFR 264.94)

Colorado Department of Health (CDH) surface water standards for Woman Creek and Walnut Creek (5 CCR 1002-8 Section 380 amended February 15 1990)

CDH Water Quality Control Commission (WQCC) statewide and classified groundwater area standards (5 CCR 1002-8 Section 311)

These treatment goals are documented in the IM/IRA Plan (DOE 1990) The treatment system is designed to achieve the treatment goals presented in the plan

1.4 IM/IRA TREATMENT SYSTEM DESCRIPTION

Based on the detected contaminants of concern DOE performed a comparative cost and performance analysis to select the optimum treatment alternative (DOE 1990) The analysis indicated oxidation of organic contaminants followed by ion-exchange polishing of inorganic contaminants as the most suited treatment option for the 881 Hillside groundwater

An ultraviolet/hydrogen peroxide (UV/H₂O₂) system was selected for oxidation of organics The system as constructed provides treatment of the groundwater at a design flow rate of 30 gpm That rate was selected on the basis of treating 14 400 gallons per day (gpd) during one 8-hour operating

shift Operating conditions were selected on the basis of bench scale testing which showed the organics were oxidized using 50 mg/L of H_2O_2 and equivalent power requirements of 240 kW The system as installed is fitted with sixteen 15-kW UV lamps

The selected ion exchange (IX) system consists of four columns containing beds of IX resins. Each of the resins is uniquely different because each column is required to perform a different function The first column IX 1 contains 28 cubic feet of a strong base anion resin (Ionac A-440) for removing uranium The second column IX 2 contains 32 cubic feet of a weak-acid cation resin (Ionac CC) for removing heavy metals The ion exchange bed in IX-3 consists of 56 cubic feet of a strong-acid resin (Ionac C 240H) for hardness and metals removal In IX-4 56 cubic feet of a weak-base anion resin (Ionac AFP-329) is provided for removal of anions

The ion exchange system also contains a degassing tower installed between IX 2 and IX-3 to allow the escape of gases such as carbon dioxide that may be released in the ion exchange process The degasser works by drawing air upward through the column as the water is allowed to fall downward in the column As with the UV/ H_2O_2 system the IX system is designed for operation at the flow rate of 30 gpm

In operation groundwater is pumped from one of the two influent holding tanks to the UV/ H_2O_2 system and then to the IX surge tank From there it is pumped through the first two IX columns (connected in series) to the degasser After degassing it is pumped through the remaining IX columns in a series to one of three effluent storage tanks Final discharge is by gravity to the south interceptor ditch (SID) The treatment system configuration is presented in Figure 1 2

1 5 PREVIOUS TREATABILITY STUDIES

The design of the treatment facility is based on sampling results reported and discussed in the IM/IRA Plan (DOE 1990) and two bench scale studies conducted by Peroxidation Systems Inc for

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the UV/H₂O₂ process In addition the IX system design basis was described by Engineering-Science Inc in its Basis of Design Report for Ion Exchange System 881 Hillside Remedial Action December 1989 (ESI 1989)

The bench scale studies conducted by Peroxidation Systems Inc consisted of testing groundwater at various pH levels and H₂O₂ dosages Peroxidation Systems Inc then prepared a process assessment to determine the most appropriate recommendations for UV/H₂O₂ treatment

The Basis of Design Report for the Ion Exchange System presented anticipated influent characteristics as well as the following information

Identification of interfaces with the UV/H₂O₂ system

Optimization of regeneration schemes to minimize volumes of spent regenerants requiring subsequent treatment

Recommendations on eliminating the concept of flow split between ion exchange and activated alumina

TITLE Test Description

2.0 TEST DESCRIPTION

This section describes the system operation and optimization tests conducted. It also provides information on the actual execution of the tests and notes any deviations from the work plan.

2.1 TEST OBJECTIVES AND RATIONALE

The test objectives were developed to verify that the process equipment and systems function as designed to handle and treat the 881 Hillside groundwater. The objectives for each specific system or process are listed below.

Groundwater Collection and Pumping System—Verify correct pump functions at the recovery well, french drain collection sumps, and the Building 891 sump. Verify that the pumps at each location turn on and off automatically as the level rises and drops in the french drain.

Influent Characterization—Determine the organic and inorganic contaminant concentrations for each influent stream (Building 881 drain, french drain, and recovery well) and compare to anticipated influent concentrations.

Influent Transfer Pumps—Determine actual flow and pressure characteristics for both transfer pumps. Also establish operational flow rates associated with pump speed settings and verify that the pumps can transfer water at 30 gpm or more through the UV/H₂O₂ treatment unit when the surge tank is full.

UV/H₂O₂ Process—The systems operation test was conducted to confirm that the system components were functional and it would oxidize the organics under the

conditions as used in earlier bench scale testing. Because the water used in bench scale tests contained some suspended solids and iron, the tests were also used to evaluate the amount of solids deposition or coating on the UV quartz tubes.

Optimization testing was done using combinations of residence time, peroxide dose, and number of UV lamps. This was done to determine if the organics could be oxidized more efficiently and also check on how residence time may affect process temperatures. Although increasing temperature would enhance the oxidation process, reactor temperature above 160°F may damage the lamps and tubes.

IX Inlet Pump—The IX inlet pump transfers water from the surge tank through two columns and a degasifier. This pump was tested for normal pumping requirements.

Intermediate IX Feed Pump—The intermediate IX feed pump transfers water from the degasifier through the final two IX columns to the effluent holding tanks. This pump must be capable of maintaining a flow rate compatible with the upstream flow rate when discharging into a full effluent tank. Testing was performed in the same manner as the IX inlet pump.

IX Columns—The IX system consists of four columns, each containing in order a strong base, weak acid, strong acid, or weak base resin. Removal of radionuclides, metals, and other pertinent ions were monitored to determine the required frequency for regeneration and the actual loadings attainable.

Degasifier—The IX degasifier located in the treatment system following the second IX column (weak acid resin) is provided to eliminate gases that may otherwise tend to come out of solution in subsequent columns and cause short circuiting in the resins. The degasifier was monitored to determine whether degasification is needed and if off-gas treatment will be necessary in a long-term groundwater treatment system.

IX Regeneration—Verify the ability of the regeneration system to operate as designed and confirm the chemical requirements for regeneration of each column. The regeneration success was evaluated by observing changes in processing efficiencies following successive regenerations.

Combined System—Confirm all processes operate as designed.

Additionally, all alarms were checked to verify their proper operation.

2.2 EXPERIMENTAL DESIGN AND PROCEDURES

This section presents the procedures followed for conducting instrument calibration and tests on the following systems:

Groundwater Collection and Pumping System

Influent Characterization

Influent Transfer System

UV/H₂O₂ System

Ion Exchange System

Combined System

The testing of the groundwater collection and pumping system and the influent transfer system along with instrument calibration was conducted to verify the equipment operated properly. If equipment did not operate properly, it was repaired or adjusted.

Once the equipment was operational, the remaining tests were conducted. The results of the influent characterization, UV/H₂O₂ system, and ion exchange system tests are presented in Section 3.0. The combined system results are presented in Section 4.0.

2 2 1 Instrument Calibration

Key instruments were calibrated before the tests began. Instruments requiring calibration and/or setting included the following:

- 1 **Pressure Gauge**—Before starting any tests, pressure gauges were removed from the treatment units and calibrated by a commercial gauge shop. They were reinstalled before starting the tests.
- 2 **Differential Pressure Gauges**—Upon startup, the IX system operating parameters were set by the manufacturer for operation at 30 gpm. Differential pressure gauges are provided on the system to indicate the amount of headloss across each of the IX columns. Under normal conditions, the gauges indicate essentially no differential. An increase in differential pressure would be the result of a flow restriction and indicate that solids were collecting in the column or that a valve may not be opening completely. Calibration of the differential pressure gauges for accuracy is not required but rather the ability to show changes. Therefore, they were checked to verify that they read a normal differential during operation and return to zero when there is no flow.
- 3 **Temperature Gauges**—Temperature gauges were calibrated during the clean water part of the tests. This calibration was conducted by the operators.
- 4 **Flowmeter**—Both of the treatment processes use paddlewheel type flowmeters to totalize flow. The meters, manufactured by Signet Scientific Company, have a solid-state digital readout.
- 5 **Level Indicators**—Level indicators were set at the correct levels when the tanks and sumps were in operation.

- 6 **Flow Switches**—Flow switches are used by the process system manufacturers to determine a low flow situation for alarm or shutdown purposes. The switch setting was initially verified during the clean water testing and adjusted as necessary.
- 7 **Level Switches**—Initially all sump and tank level switches were set when there was sufficient water to start the tests.
- 8 **pH Meters**—pH meter calibration was checked using a standard pH reference solution by the plant operators each time the system is started up. This is typically on a daily frequency.
- 9 **Conductivity Meters**—Three conductivity meters are installed on the ion exchange system. These were checked and recalibrated by Bruner as required at initial startup.

2.2.2 Groundwater Collection and Pumping System

The system consists of a recovery well pump, french drain sump pumps (2) and Building 891 sump pumps (2). In each installation, the constant speed pumps are controlled by level switches in a well or sump. Testing consisted of verifying that the pumps are operable and that they turn on and off at the desired level (level switches were set properly for automatic operation). The following were the testing procedures used for each location:

- 1 Review pump curves to determine operating settings.
- 2 Verify that the valves are open from the pump(s) to equalization/storage tanks including the motorized inlet valve at the tank to be filled.
- 3 Confirm that there is water in the sump or well being tested.

- 4 Energize the pump circuit at the control panel so that the pump can be started and stopped locally
- 5 Place the local pump switch in the on position and verify that the pump operates and pumps the level down
- 6 Move the switch to the auto position and observe the level when the pump starts and stops
- 7 Adjust the level switches as necessary to change the start or stop level
- 8 Repeat steps 2 to 6 for each pump

2 2 3 Influent Characterization

Influent characterization consisted of sampling the influent. The procedure was to sample each waste stream (Building 881 footing drain french drain and recovery well designation CW001) for volatile organics metals radionuclide anions and TDS

2 2 4 Influent Transfer System

Groundwater from the 881 Hillside area is collected and pumped to one of two influent equalization tanks at the treatment facility Two influent transfer pumps are provided to transfer the water from the equalization tanks to the UV/H₂O₂ process The influent transfer system was tested before subsequent systems were tested The test procedure was conducted using the following steps

- 1 Verify that one of the influent equalization tanks contains a minimum of 2,000 gallons before starting the test.

- 2 Open the valve at the outlet from the influent equalization tank containing water for the test. Also open the valves (inlet and outlet) at the pump being tested and verify that the other treatment system valves are open to allow water to flow through the UV/H₂O₂ unit to the IX surge tank
- 3 Verify that the pump disconnect at the motor control center (MCC) is in the ON position and that the hand switch at the programmable logic controller (PLC) is in the OFF position
- 4 Start the pump by moving the switch at the PLC to the AUTO position
- 5 Visually confirm that the pump is running and that the flow rate (flowmeter reading) is 10 gpm
- 6 Observe and record the pump discharge pressure gauge indication
- 7 Verify that there are no leaks in the transfer piping
- 8 Increase the pumping rate (pump speed) to 30 gpm and record the pump discharge pressure
- 9 Recheck to determine that there are no system leaks
- 10 Increase the pumping rate to the maximum setting (if the maximum setting was not already attained) and record the flow rate and pump discharge pressure
- 11 Stop the influent transfer pump
- 12 Close the pump inlet and outlet valves for the pump previously tested and open the inlet and outlet valves for the other transfer pump

13 Repeat steps 2 through 12 above for testing the second transfer pump

2 2 5 UV/H₂O₂ System

Process testing of the UV/H₂O₂ unit consisted of evaluating organic destruction at various flow rates (residence time) H₂O₂ concentrations and UV intensity. The test also evaluated the potential for fouling of the quartz tubes. Each test was conducted using the following steps:

- 1 Confirm that the influent equalization tank has sufficient water to conduct the test. The tank should contain at least 10 000 gallons.
- 2 Open the valves to allow water to flow from the tank through the UV/H₂O₂ unit and to the surge tank.
- 3 Start the influent transfer pump and establish a flow rate of 30 gpm.
- 4 Energize the UV lamps in Reactor No. 1.
- 5 Energize the UV lamps in Reactor No. 2.
- 6 Start the H₂O₂ feed pump.
- 7 Check and record the following at 15-minute intervals:

Flow rate

Pump discharge pressure

Reactor inlet temperature

Reactor outlet temperature

- 8 After 1 hour of operation collect samples at the UV/H₂O₂ unit inlet and outlet and at the outlet from the first reactor
- 9 Change the H₂O₂ feed setting and repeat steps 7 and 8 above
- 10 Change the flow rate to 15 gpm
- 11 Repeat Step 7
- 12 Repeat Step 8
- 13 While maintaining the 15 gpm flow rate return the H₂O₂ dose to its initial value
- 14 Repeat Step 7
- 15 Repeat Step 8
- 16 Turn off the UV lamps and H₂O₂ pump
- 17 Stop the transfer pump and close the equalization tank outlet valve
- 18 Check UV quartz tubes fouling

2 2 6 Ion Exchange System

The IX tests are established to confirm the system capability to pass the 30-gpm flow while removing the individual inorganic constituents metals and radionuclides to levels below the ARARs

The IX system consists of the IX surge tank a feed pump an intermediate pump four IX columns a degasifier and a regeneration system

Tests were conducted using the following procedures

- 1 Regenerate each column in accordance with instructions contained in the IX system O&M manual provided by the manufacturer
- 2 Verify that the surge tank contains at least 10 000 gallons of UV/H₂O₂ treated water for use in the test.
- 3 Set the IX system valves to allow water to flow through the columns to one of the effluent tanks
- 4 Start the IX feed pump intermediate pump and degasifier blower
- 5 Measure and record pressure temperature flow rate pH and conductivity
- 6 After 2 and 4 hours of operating the IX system collect effluent samples from each column and composite them (two for each column) for analysis in accordance with the SAP (Appendix C) of the work plan manual (EG&G 1992)
- 7 Collect off gas samples from the degasifier for analysis in accordance with the SAP (Appendix C) of the work plan manual (EG&G February 1992)
- 8 Repeat steps 4 through 7 to evaluate the IX system for water generated by each test of the UV/H₂O₂ process

2 2 7 Combined System

Testing of the combined system was conducted to confirm that all processes operate as designed. The procedures described previously for operating the individual processes were followed. The H₂O₂ dosage from previous UV/H₂O₂ testing and the design flow rate was used during this test.

2.3 SAMPLING AND ANALYSIS

Samples were collected for the following reasons

Characterization of influent or effluent

Treatment system testing and evaluation

Rad screens to confirm whether various waters are suitable for shipping or disposal

Additionally the analytical parameters for the samples varied depending on the purpose of the sample. A complete list of the samples collected, their purpose, location collected, and analytical results is presented in Appendix A of this document.

The equipment and materials used for the tests were the components of the treatment system. No specialized equipment was necessary to conduct the tests. The only additional equipment used was as follows:

H₂O₂ test strips—to determine the residual hydrogen peroxide in the water following UV/H₂O₂ treatment

pH meter—to determine the pH at various points within the treatment system

Peristaltic pump—to filter water samples for dissolved metal analysis

2.4 DEVIATIONS FROM THE WORK PLAN MANUAL

This section outlines the deviations from the Work Plan (EG&G 1992). The deviations are presented by test and in the same order as they are presented in the Work Plan.

2 4 1 Instrument Calibration

Although most of the instruments were calibrated as specified in the Work Plan there were a few instruments that were not. These instances are discussed below.

2 4 1 1 Temperature Gauges

The temperature gauges were anticipated to be calibrated by a commercial gauge shop. A commercial gauge shop that calibrated temperature gauges was not located. Therefore the temperature gauges were calibrated by the treatment plant operators. The method used to calibrate the gauges was as follows:

Chill water until it just begins to freeze (32°F)

Verify the 32°F temperature with a thermometer

Check the temperature with the temperature gauge and adjust if necessary

2 4 1 2 Flowmeters

The flowmeters are paddle wheel type with digital readout and were supplied as factory calibrated units. Although field calibration was not conducted, they were checked using a bucket and stopwatch.

2.4 1 3 Electrical Ammeters

The electrical ammeters were to be checked for calibration in accordance with the manufacturer's instructions. This was not completed because the ammeters are not intended to measure the actual current to the lamps but rather provide an indication of lamp performance and operation.

2 4 2 Groundwater Collection and Pumping System

Step 6 in the Work Plan required the pump to operate in the automatic mode. The pump system was only operational in its manual mode at the time it was started up; it now operates automatically as designed.

2 4 3 Influent Characterization

The Work Plan specified that each waste stream would be analyzed for volatile organics, metals, radionuclides, anions, and TDS. Sampling point No. 3 at the collection well contains water from the 881 footing drain and recovery well (CW001) as well as from the french drain. It is not possible to isolate groundwater from the french drain because groundwater within the french drain is a mixed stream. Groundwater from the Building 881 footing drain and from the recovery well were isolated and sampled for volatile and semivolatile organics. Groundwater from these two sampling points was not analyzed for metals, radionuclides, anions, or TDS because the sampling points are characterized by organic contamination (see Subsection 1 2).

2 4 4 Influent Transfer System

Step 5 in the Work Plan required the pump to operate in the automatic mode. This pump was operational only in the manual mode at the time of this test. This situation has recently been corrected.

Additionally, the Work Plan stated that jar tests may be needed to be conducted if iron concentrations were sufficient to precipitate on the UV quartz tube or otherwise reduce the efficiency of the UV/H₂O₂ system. Jar testing would consist of bench-scale tests to evaluate precipitation, coagulation, and settling of iron and suspended solids. Iron concentrations did not affect the operation of the UV/H₂O₂ system, including coating of the UV quartz tube. Therefore, the jar tests were not conducted.

2 4 5 UV/H₂O₂ System

In the testing of the UV/H₂O₂ system the following parameters were to be checked and recorded at 15-minute intervals

Flow rate

Pump discharge pressure

Reactor outlet temperature

Reactor UV light intensity

These parameters were checked and initially recorded at 15-minute intervals but were later checked and recorded at 30-minute intervals during testing. This change was made because the parameters did not significantly change over time.

Also, step 8 of the procedure required sample collection after 1 hour of operation. Generally, samples were collected after 2 hours of operation. This change allowed the system more time to achieve steady state and compensated for longer residence time requirements at low flow rates.

2 4 6 Ion Exchange System

Step 4 of the ion-exchange system test procedures required the initial test be conducted at 15 gpm. As discussed previously, the IX system is designed and set up to operate at 30 gpm.

Instead of collecting samples after 2 hours of operation, they were collected only after 4 hours. This change was made to allow time for the water in all of the columns to be completely displaced before sampling. Compositing of samples was also eliminated because only grab samples are needed to evaluate inorganic removal by ion exchange.

Since testing could be conducted at only one flow rate as discussed, Step 8 was deleted.

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Step 9 required repeating the test using the water generated by each test of the UV/H₂O₂ process. This was not conducted because the effluent quality from the UV/H₂O₂ system remained unchanged.

2.4.7 Combined System

It was originally anticipated that one sample would be collected daily from all sampling locations and analyzed for the full suite of parameters. This was not conducted. Originally the combined system test was only to run for a few days. Because of operational problems such as the need to retreat effluent water and the length of time to discharge the column regenerant, the combined system test was conducted over a few months.

TITLE Results and Discussion

3 0 RESULTS AND DISCUSSION

This section presents the results of systems operation monitoring for four operations. The operations analyses are presented in a series of data tables and interpreted in Subsection 3.1. Subsection 3.2 addresses systems operation equipment failures, subsequent repairs, or recommendations for improved equipment operations.

3 1 DATA ANALYSIS AND INTERPRETATION

The following subsections provide an overview of the results of the systems operation monitoring. The results are divided into four main sections: (1) characterization of system influent, (2) UV/H₂O₂ organic oxidation system, (3) ion-exchange system, and (4) air sampling. Data used in this analysis and interpretation were obtained from specific test runs and routine operations between March 31 and September 21, 1992. A total of 106 samples were collected during this period. A complete list of sample numbers, sample points, dates, and available analytical results is included in Appendix A of this document.

3 1 1 Influent Characterization

The treatment system was designed to treat a wide range of organic and inorganic constituents. The anticipated concentrations were higher than the concentrations actually seen. Table 3-1 summarizes maximum concentrations of parameters that were expected and that were seen. Table 3-2 presents a more detailed characterization of the groundwater currently being treated.

Organic compounds consistently detected in the system influent samples included tetrachloroethene and trichloroethene. Compounds detected less frequently in the samples included 2-butanone, acetone, 1,1-dichloroethane, 1,1,1-trichloroethane, and toluene. Chloroform and methylene chloride

TABLE 3-1

COMPARISON OF EXPECTED CONCENTRATIONS
AND ACTUAL CONCENTRATIONS

Analyte	Actual Maximum Concentration	Expected Maximum Concentration ^b	ARAR Value
Organics µg/L			
2 Butanone	120 0	NR ^c	NS
Tetrachloroethene	39 0	NR	5 0U
Acetone	27 0	NR	50 0
1 1 Dichloroethane	ND	180J	5 0U
1 1 1 Trichloroethane	18 0	15 000	200 0
Trichloroethene	21 0	11 000	5 0
Toluene	20 0	NR	2,000
1 1 Dichloroethene	17 00	7 900J	7 0
Carbon tetrachloride	ND	2,400J	5 0
1 1 2 Trichloroethane	ND	5 900J	5 0
1 2 Dichloroethane	ND	17J	5 0
Inorganics mg/L			
Aluminum	0 44	NR	5 0
Antimony	ND	0 080	0 06
Arsenic	0 0029	NR	0 05
Barium	0 33	0 177	1 0
Calcium	247 0	356 0	NS
Cesium	ND	0 040J	NS
Chromium	0 066	0 078	0 05
Copper	0 016	0 952	0 2
Iron	0 68	0 174	0 3

Appendix A, Draft Systems Operation and Optimization Test Report, EG&G October 1992 Samples from Points 1 2 3 and 4 represented

^bTable 2.2 Work Plan Manual for the Startup Operation and Maintenance of the IM/IRA, EG&G February 1992.

^cFrom Sample Point 7

Notes	J	=	Estimated value	NS	=	Not specified
	mg/L	=	milligrams per liter	U	=	Below detection limits
	ND	=	Not detected	µg/l	=	micrograms per liter
	NR	=	Not reported			

TABLE 3-1

COMPARISON OF EXPECTED CONCENTRATIONS
AND ACTUAL CONCENTRATIONS
(Continued)

Analyte	Actual Maximum Concentration ^a	Expected Maximum Concentration ^b	ARAR Value
Lead	0 0082	NR	0 05
Lithium	0 03	0 700	2 5
Magnesium	19 6	73 3	NS
Mercury	ND	0 0003	0 002
Molybdenum	0 08	0 0265	0 1
Nickel	ND	0 864	0 2
Potassium	30 8	12.3	NS
Selenium	0 22	3 2	0 01
Silicon	7 0	NR	NS
Sodium	134 0	342	NS
Strontium	2.7	2.43	NS
Vanadium	0 027	0 030	0 1
Zinc	0 43	2 45	2.0
Bicarbonate	510 0	502	NS
Carbonate	53 4	NR	NS
Chloride	158 0	458	250 0
Fluoride	0 94	NR	NS
Nitrate/nitrite	2 630	55	10 0
Sulfate	127	7 000	250 0
Total suspended solids	13 0	NR	NS

Appendix A, Draft Systems Operation and Optimization Test Report, EG&G October 1992 Samples from Points 1 2 3 and 4 represented

^aTable 2.2, Work Plan Manual for the Startup Operation and Maintenance of the IM/IRA, EG&G February 1992

^bFrom Sample Point 7

Notes	J	=	Estimated value	NS	=	Not specified
	mg/L	=	milligrams per liter	U	=	Below detection limits
	ND	=	Not detected	µg/l	=	micrograms per liter
	NR	=	Not reported			

TABLE 3-1

COMPARISON OF EXPECTED CONCENTRATIONS
AND ACTUAL CONCENTRATIONS
(Concluded)

Analyte	Actual Maximum Concentration	Expected Maximum Concentration ^b	ARAR Value
Total dissolved solids	470 0	2 374	400 0
Radionuclides pCi/L			
Americium 241	0 007	NR	4
Americium 243	trace	NR	NS
Hydrogen-3 (Tritium)	219 8	777	20 000
Plutonium 236	0 002	NR	NS
Plutonium 238	0 001	NR	
Plutonium 239	0 013	NR	15 0 (Pu-238 239 240)
Plutonium 242	trace	NR	NS
Strontium 90	3 26	2.1	8 0
Uranium 232	trace		
Uranium 234	3 92		
Uranium 235	0 40		
Uranium 238	2.89	54 6 (total for uranium 232 234 235 238)	40 0 (total for uranium-232, 234 235 238)
Gross Alpha	2 07 ^c	319	15
Gross Beta	4 04	286	50

Appendix A Draft Systems Operation and Optimization Test Report, EG&G October 1992. Samples from Points 1, 2, 3 and 4 represented

^bTable 2-2 Work Plan Manual for the Startup Operation and Maintenance of the IM/IRA, EG&G February 1992.

^cFrom Sample Point 7

Notes	J	=	Estimated value	NS	=	Not specified
	mg/L	=	milligrams per liter	U	=	Below detection limits
	ND	=	Not detected	µg/l	=	micrograms per liter
	NR	=	Not reported			

Table 3-2

**SUMMARY OF ORGANIC INORGANIC AND RADIONUCLIDE
CONTAMINANTS DETECTED IN SYSTEM INFLUENT**

Analyte	Number of Detects	Mean Concentration	Standard Deviation	Number of Nondetects	ARAR Value
Organics, µg/L					
2 Butanone	1	120 0	0	12	NS
Tetrachloroethene	13	18 84	8 41	0	5U
Acetone	1	27 0	0	12	50
1 1 Dichloroethene	1	17 0	0	12	5U
1 1 1 Trichloroethane	1	18 0	0	12	200
Trichloroethene	7	39 66	75 06	6	5
Toluene	1	20 0	0	12	2,000
Inorganics mg/L					
Aluminum	4	0 18	0 19	3	5
Arsenic	4	0 003	0 0005	3	0 05
Barium	7	0.25	0.27	0	1
Calcium	7	101 80	64 94	0	NS
Chromium	3	0 03	0 03	4	0 05
Copper	5	0 01	0 01	2	0.20
Iron	7	0.21	0.26	0	0 30
Lead	2	0 01	0 0003	5	0 05
Lithium	6	0 01	0 01	0	2.5
Magnesium	7	15 00	7 03	0	NS
Manganese	3	0 01	0 01	4	0 05
Molybdenum	2	0 04	0 05	5	0 10
Potassium	7	7 48	10 43	0	NS
Selenium	7	0 04	0 08	0	0 01
Silicon	6	5 48	1 61	0	NS
Sodium	7	60 14	33 96	0	NS
Strontium	7	0 86	0 81	0	NS
Vanadium	2	0 02	0 02	5	0 10
Zinc	7	0 047	0 01	0	2 0
Bicarbonate	6	257 17	124 64	0	NS
Carbonate	2	31 80	30 55	4	NS
Chloride	7	98 53	38.21	0	250 0
Fluoride	7	0 82	0 13	0	NS

Note U = Below detection limits

Table 3-2

**SUMMARY OF ORGANIC INORGANIC AND RADIONUCLIDE
CONTAMINANTS DETECTED IN SYSTEM INFLUENT
(Concluded)**

Analyte	Number of Detects	Mean Concentration	Standard Deviation	Number of Nondetects	ARAR Value
Nitrate/Nitrite	7	1 042.96	1 300 67	0	10
Sulfate	7	60.20	29 59	0	250 0
Total Suspended Solids	2	9.25	5 36	5	NS
Total Dissolved Solids	7	362.43	162.06	0	400
Radionuclides, pCi/L					
Americium-241	2	0 004	0 004	3	4
Hydrogen-3	4	164 53	50 58	0	20 000
Plutonium-236	1	0 002	0	0	NS
Plutonium-238	3	0 01	0 16	2	
Plutonium-239	4	0 007	0 006	1	15 (Pu-238 -239 -240)
Strontium-90	4	1 88	1 35	0	8
Uranium-234	5	2.24	1 68	0	
Uranium-235	5	0 24	0 20	0	
Uranium-238	4	1 95	1 05	1	40 (total uranium)
Gross Alpha	2	2.01	0 08	0	15
Gross Beta	2	38 73	2 36	0	50

Note U = Below detection limits

were also detected in some influent samples however contamination of the method blanks for these samples suggests that they are laboratory contaminants and do not reflect actual system influent concentrations. The system influent also contained detectable concentrations of the following inorganics: aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, lithium, magnesium, manganese, molybdenum, potassium, selenium, silicon, sodium, strontium, zinc, bicarbonate, chloride, fluoride, nitrate, and sulfate. The majority of inorganics were primarily (greater than 75 percent) in a soluble form (refer to Subsection 3.1.3.1). Exceptions to this were iron, potassium, and zinc which were primarily present in particulate form. Additionally, the influent water contained detectable levels of gross alpha/beta, strontium-90, tritium (hydrogen-3), and uranium (234, 235, and 238). Americium-241 and plutonium (236, 238, 239, 242) levels were at least three orders of magnitude below ARARs.

3.1.2 UV/H₂O₂ System

The evaluation of the UV/H₂O₂ treatment system consisted of three phases. First, the system was tested for its removal efficiency of VOCs in the influent water using treatment parameters previously established in bench-scale testing. Second, the possibility that the oxidation process produced undesirable byproducts was addressed. Finally, operating conditions of the system were adjusted to allow evaluation of the relative effectiveness of varying combinations of flow rate, peroxide dose, and UV intensity (the latter measured by the number of operating lamps).

3.1.2.1 Organic Removal Efficiency

The VOC removal efficiency of the UV/H₂O₂ organic oxidation unit was evaluated on five occasions: March 31, April 1, April 6, June 9, and July 22, 1992. During operation of the UV/H₂O₂ system, three parameters can be varied to optimize the removal of organics: flow rate, peroxide dose, and UV intensity (number of UV lamps operating). For the five evaluations of removal efficiency, the system was operated under constant conditions of 30 gallons per minute (gpm), 50 mg/L hydrogen peroxide, and 16 lamps. The results of these tests are summarized in Tables 3-3, 3-4, 3-5, 3-6, and 3-7. While the majority of the organic compounds assayed were below detectable concentrations in the

TABLE 3-3

ANALYTICAL RESULTS FOR UV/H₂O₂ ORGANIC OXIDATION UNIT TRIAL NO 1
MARCH 31 1992

Analyte	Influent Concentration (µg/L)	Effluent Concentration (µg/L)	ARAR Value (µg/L)
2 Butanone	10 0U	10 0U	NS
Tetrachloroethene	18 2	5 0U	5 0U
Acetone	10 0U	10 0U	50
1 1 Dichloroethene	5 0U	5 0U	5 0U
1 1 1 Trichloroethane	5 0U	5 0U	200
Trichloroethene	5 0U	5 0U	5 0
Toluene	5 0U	5 0U	2,000
Ethylbenzene	5 0U	9 1	NS
Xylene (Total)	5 0U	36 2	NS
Chloroform	5 7	7 1	NS
4-Methyl 2 pentanone	10 0U	110 9	NS
Methylene chloride	3 4	4 1	5 0U

Notes Influent = Sampling Port 4
Effluent = Sampling Port 7
U = Analyte not detected the detection limit is shown on the left.
Operating parameters 30 gpm flow rate 50 mg/L hydrogen peroxide 16 UV lamps

TABLE 3-4

ANALYTICAL RESULTS FOR UV/H₂O₂ ORGANIC OXIDATION UNIT
TRIAL NO 2
APRIL 1 1992

Analyte	Influent Concentration (µg/L)	Effluent Concentration (µg/L)	ARAR Value (µg/L)
2 Butanone	10 0U	10 0U	NS
Tetrachloroethene	14 7	5 0U	5 0U
Acetone	10 0U	54 6	50
1 1 Dichloroethene	5 0U	5 0U	5 0U
1 1 1 Trichloroethane	5 0U	5 0U	200
Trichloroethene	5 0U	5 0U	5 0
Toluene	5 0U	5 0U	2 000
Ethylbenzene	5 0U	5 0U	NS
Xylene (Total)	5 0U	5 0U	NS
Chloroform	5 0U	5 0U	NS
4-Methyl 2 pentanone	10 0U	10 0U	NS
Methylene chloride	4 1	3 7	5 0U

Notes Influent = Sampling Port 4
 Effluent = Sampling Port 5
 U = Analyte not detected the detection limit is shown on the left.
 Operating parameters 30 gpm flow rate 50 mg/L hydrogen peroxide 16 UV lamps

TABLE 3-5

ANALYTICAL RESULTS FOR UV/H₂O₂ ORGANIC OXIDATION UNIT
TRIAL NO 3
APRIL 1 1992

Analyte	Influent Concentration (µg/L)	Effluent Concentration (µg/L)	ARAR Value (µg/L)
2 Butanone	10 0U	10 0U	NS
Tetrachloroethene	15 0	5 0U	5 0U
Acetone	10 0U	11 0	50
1 1 Dichloroethene	5 0U	5 0U	5 0U
1 1 1 Trichloroethane	5 0U	5 0U	200
Trichloroethene	5 0U	5 0U	5 0
Toluene	5 0U	5 0U	2 000
Ethylbenzene	5 0U	5 0U	NS
Xylene (Total)	5 0U	5 0U	NS
Chloroform	5 0U	5 0U	NS
4-Methyl 2 pentanone	10 0U	10 0U	NS
Methylene chloride	5 0U	5 0U	5 0U

Notes Influent = Sampling Port 4
 Effluent = Sampling Port 5
 U = Analyte not detected the detection limit is shown on the left.
 Operating parameters 30 gpm flow rate 50 mg/L hydrogen peroxide 16 UV lamps

TABLE 3-6

ANALYTICAL RESULTS FOR UV/H₂O₂ ORGANIC OXIDATION UNIT TRIAL NO 4
APRIL 1 1992

Analyte	Influent Concentration (µg/L)	Effluent Concentration (µg/L)	ARAR Value (µg/L)
Organics			
2 Butanone	10 0U	10 0U	NS
Tetrachloroethene	13 0	5 0U	5 0U
Acetone	10 0U	10 0U	50
1 1 Dichloroethene	5 0U	5 0U	5 0U
1 1 1 Trichloroethane	5 0U	5 0U	200
Trichloroethene	8 0	5 0U	5 0
Toluene	5 0U	5 0U	2,000
Ethylbenzene	5 0U	5 0U	NS
Xylene (Total)	5 0U	5 0U	NS
Chloroform	5 0U	5 0U	NS
4-Methyl 2 pentanone	10 0U	10 0U	NS
Methylene chloride	21 0	5 0	5 0U

Notes Influent = Sampling Port 4
Effluent = Sampling Port 5
U = Analyte not detected the detection limit is shown on the left.
Operating parameters 30 gpm flow rate 50 mg/L hydrogen peroxide 16 UV lamps

TABLE 3-7

ANALYTICAL RESULTS FOR UV/H₂O₂ ORGANIC OXIDATION UNIT TRIAL NO 5
APRIL 1 1992

Analyte	Influent Concentration (µg/L)	Effluent Concentration (µg/L)	ARAR Value (µg/L)
Organics			
2 Butanone	10 0U	10 0U	NS
Tetrachloroethene	12 0	5 0U	5 0U
Acetone	10 0U	10 0U	50
1 1-Dichloroethene	5 0U	5 0U	5 0U
1 1 1 Trichloroethane	5 0U	5 0U	200
Trichloroethene	16 0	5 0U	5 0
Toluene	5 0U	5 0U	2,000
Ethylbenzene	5 0U	5 0U	NS
Xylene (Total)	5 0U	5 0U	NS
Chloroform	5 0U	5 0U	NS
4-Methyl 2 pentanone	10 0U	10 0U	NS
Methylene chloride	2 0	2.0	5 0U

Notes Influent = Sampling Port 4
 Effluent = Sampling Port 5
 U = Analyte not detected the detection limit is shown on the left.
 Operating parameters 30 gpm flow rate 50 mg/L hydrogen peroxide 16 UV lamps

influent tetrachloroethene existed in measurable concentrations in the influent during each test. Additionally trichloroethene was identified in the test influent during trials 4 and 5 (Tables 3-6 and 3-7 respectively) The UV/H₂O₂ unit reduced these contaminants to specified ARAR limits in each test Methylene chloride was detected during trials 1, 2, 4 and 5 Data qualifiers are currently available for trials 4 and 5 these indicate that methylene chloride was detected in method blanks during laboratory analysis of these samples This indicates that methylene chloride is a laboratory contaminant and not a component of the system influent. Chloroform was also detected during trial 1 this is also suspected to be a laboratory contaminant

In addition some organics were detected in effluent samples that were not detected in the influent water as shown on Tables 3-3 (ethylbenzene 4-methyl 2 pentanone and xylene) 3-4 (acetone) and 3-5 (acetone) Acetone is a common laboratory chemical and is considered to be a laboratory contaminant in the two tests as noted However the ethylbenzene 4-methyl-2 pentanone and xylene shown in the effluent from trial 1 are thought to be contaminants introduced to the water by plastic piping systems and surge tank coating constituents after the oxidation process PVC cement systems contain the detected organics as does the vinyl epoxy tank coating An evaluation of the ratio of the organics detected in the water shows they are the same as their ratio in the coating Because ethylbenzene 4-methyl-2 pentanone and xylene were not detected in Tests 2, 3, 4 and 5 it is assumed that they were flushed from the system in the earlier test.

The Material Safety Data Sheet (MSDS) for Tank 203 coatings shows that the coatings include xylene 4-methyl 2 pentanone and ethylbenzene The organics were detected in the waste stream following the UV/H₂O₂ system but were not detected in the influent MSDSs are included in Appendix B for all tank coatings and ion exchange resins

3.1.2.2 By Product Assessment

In order to address the possibility that the oxidation process was introducing undesirable by products into the effluent water analysis was conducted on August 25, 1992 for the presence of semi volatile organic compounds in the treatment water Table 3-8 provides a complete list of semi vola

TABLE 3-8

LIST OF SEMI VOLATILE ORGANIC COMPOUNDS ANALYZED
FOR DURING BY-PRODUCT ASSESSMENT
AUGUST 25 1992

Analyte	Detection Limit (µg/L)
Phenol	10
bis (2-Chloroethyl) Ether	10
2-Chlorophenol	10
1 3-Dichlorobenzene	10
1 4-Dichlorobenzene	10
Benzyl Alcohol	10
1 2 Dichlorobenzene	10
2-Methylphenol	10
bis (2-Chloroisopropyl) Ether	10
4-Methylphenol	10
N Nitroso-Di n Propylamine	10
Hexachloroethane	10
Nitrobenzene	10
Isophorone	10
2-Nitrophenol	10
2 4-Dimethylphenol	10
Benzoic Acid	50
bis (2-Chloroethoxy) Methane	10
2 4-Dichlorophenol	10
1 2 4-Trichlorobenzene	10
Naphthalene	10
4-Chloroaniline	10
Hexachlorobutadiene	10
4-Chloro-3-Methylphenol	10
2 Methylnaphthalene	10
Hexachlorocyclopentadiene	10
2 4 6-Trichlorophenol	10

TABLE 3-8

LIST OF SEMI VOLATILE ORGANIC COMPOUNDS ANALYZED
FOR DURING BY-PRODUCT ASSESSMENT AUGUST 25 1992
(Continued)

Analyte	Detection Limit (µg/L)
2 4 5-Trichlorophenol	50
2-Chloronaphthalene	10
2-Nitroaniline	50
Dimethyl Phthalate	10
Acenaphthylene	10
2 6-Dinitrotoluene	10
3 Nitroaniline	50
Acenaphthene	10
2 4-Dinitrophenol	50
4-Nitrophenol	50
Dibenzofuran	10
2,4-Dinitrotoluene	10
Diethylphthalate	10
4-Chlorophenyl-phenylether	10
Fluorene	10
4-Nitroaniline	50
4 6-Dinitro-2-Methylphenol	50
N Nitrosodiphenylamine	10
4-Bromophenyl-phenylether	10
Hexachlorobenzene	10
Pentachlorophenol	50
Phenanthrene	10
Anthracene	10
Di n Butylphthalate	10
Fluoranthene	10
Pyrene	10

TABLE 3-8

**LIST OF SEMI VOLATILE ORGANIC COMPOUNDS ANALYZED
FOR DURING BY-PRODUCT ASSESSMENT AUGUST 25 1992
(Concluded)**

Analyte	Detection Limit (µg/L)
Butylbenzylphthalate	10
3 3 Dichlorobenzidine	20
Benzo (a) Anthracene	10
Chrysene	10
bis (2 Ethylhexyl) Phthalate	10
Di n-Octyl Phthalate	10
Benzo (b) Fluoranthene	10
Benzo (k) Fluoranthene	10
Benzo (a) Pyrene	10
Indeno (1 2,3-cd) Pyrene	10
Dibenz (a,h) Anthracene	10
Benzo (g h i) Perylene	10

tiles tested for. Samples were taken from sample ports 4, 5, 7, 9, 11, and 18 (three samples/port). Table 3-9 provides a complete list of the compounds detected during this test. There were only ten hits during this analysis: diethylphthalate (two hits), benzoic acid (five hits), naphthalene (one hit), bis(2-ethylhexyl) phthalate (one hit), and polydimethylsiloxane (one hit). Because these compounds were not detected at the UV/H₂O₂ system influent, it is assumed that these semi-volatiles were introduced by the resins or by PVC cement and primer in the system piping. It is concluded that the oxidation process does not produce any undesirable by-products.

3.1.2.3 Comparison of UV/H₂O₂ System Operating Parameters

Tests were conducted on August 25 to determine the effect of varying operating conditions on the UV/H₂O₂ system's ability to oxidize VOCs. Test conditions and results are summarized in Table 3-10. Only tetrachloroethene (11 to 12 µg/L) and trichloroethene (16 to 21 µg/L) were consistently detected in the system influent; each contaminant was reduced to detection limits in all trials. These results indicate that at a flow rate of 15 or 30 gpm, only 8 lamps and 50 mg/L H₂O₂ are needed to efficiently oxidize these concentrations of tetrachloroethene and trichloroethene. Monitoring system water temperatures during these tests revealed that a temperature increase of more than 25°C occurred when 16 lamps are operating, whereas treatment water temperature increases of less than 15°C occurred when only eight lamps were operating.

The bench scale tests indicated that optimum oxidation of the organics occurred at approximately pH 4.0 to 4.5. However, the full scale UV system has no provision for adjusting pH. Therefore, all testing was conducted at the incoming water pH.

3.1.3 Ion Exchange System

The inorganic and radionuclide removal capacity of the ion-exchange system was evaluated using data collected during system operation testing on June 9 and July 22, 1992.

TABLE 3-9

SEMI VOLATILE ORGANIC COMPOUNDS DETECTED IN
SYSTEM TREATMENT WATER
AUGUST 25 1992

Analyte	No of Hits	Sample Port	Concentration
Diethylphthalate	2	7	3 µg/L J
		9	5 µg/L J
Benzoic acid	5	9	19 µg/L J
		9	31 µg/L J
		11	19 µg/L J
		11	31 µg/L J
		18	10 µg/L J
Naphthalene	1	18	7 µg/L J
Bis (2-ethylhexyl phthalate)	1	5	5 µg/L J
Polydimethylsiloxane	1	4	11 µg/L J

Notes J = estimated value

TABLE 3-10

COMPARISON OF THE UV/H₂O₂ ORGANIC OXIDATION SYSTEM
UNDER FOUR SETS OF TEST PARAMETER COMBINATIONS

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)
Organics		
Test No 1		
Trichloroethene	21	5 0U
Tetrachloroethene	12	5 0U
Test No 2		
Trichloroethene	16	5 0U
Tetrachloroethene	11	5 0U
Test No 3		
Trichloroethene	16	5 0U
Tetrachloroethene	11	5 0U
Test No 4		
Trichloroethene	16	5 0U
Tetrachloroethene	11	5 0U

Notes Influent = Sampling Port 4
Effluent = Sampling Port 5
U = Analyte not detected

Test No 1 Flow rate 15 gpm
Peroxide dose 35 mg/L
No of lamps 16

Test No 3 Flow rate 15 gpm
Peroxide dose 50 mg/L
No of lamps 8

Test No 2 Flow rate 15 gpm
Peroxide dose 50 mg/L
No of lamps 16

Test No 4 Flow rate 30 gpm
Peroxide dose 50 mg/L
No of lamps 8

3 1 3 1 Metal and Inorganic Removal Efficiency

Metal and inorganic removal efficiency testing was conducted June 9 1992. Table 3-11 provides a summary of the effectiveness of the entire system from the ion-exchange influent (sampling port 7) to the final system effluent (sampling port 18). Only selenium and TDS concentrations were above the specified ARARs in the test influent. The following inorganic concentrations were effectively removed (>70 percent) by the system: calcium, magnesium, sodium, zinc, chloride, and TDS. Additionally, the following inorganics were reduced below detection limits: arsenic, barium, copper, lithium, selenium, strontium, bicarbonate, sulfate, and total suspended solids (TSS). There are several discrepancies in the data set, including greater dissolved than total concentrations of copper, chromium, iron, lead, lithium, manganese, magnesium, silicon, sodium, and vanadium. These discrepancies suggest that small percentages of inorganic removal (e.g., <20 percent) or concentrations near the detection limit may be attributable to laboratory or sampling error.

Removal efficiencies for each component of the ion-exchange unit are summarized in Table 3-12 (ion-exchange column No. 1), Table 3-13 (ion-exchange column No. 2), Table 3-14 (ion-exchange column No. 3), and Table 3-15 (ion-exchange column No. 4). Although column No. 1 is a non-regenerable column and was designed only to remove radionuclides, several inorganics were also removed during this trial, including arsenic, copper, iron, potassium, selenium, zinc, and sulfate. These reductions may be partially attributed to particulate filtration by the ion exchange system influent bag filter. Total suspended solids were also removed to below detection limits. Column No. 2 was designed to remove soluble metals and hardness; during this trial, the column effectively reduced concentrations of barium, vanadium, and zinc. Bicarbonate was also removed. Column No. 3 was designed to further reduce metal concentrations as well as major cations (e.g., calcium). Inorganics removed by this column included barium, calcium, iron, lithium, magnesium, sodium, and strontium. The effectiveness of this column is demonstrated by a large reduction (88 percent) in total dissolved solids. Column No. 4 was primarily responsible for chloride reduction.

TABLE 3-11

ANALYTICAL RESULTS FOR THE ION EXCHANGE SYSTEM

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal	ARAR (mg/L)
Metals and Inorganics				
Aluminum	0 029U	0 029U	--	5 0
Dissolved Aluminum	0 029U	0 029U	--	
Arsenic	0 0029	0 0007U		0 05
Dissolved Arsenic	0 0022	0 0007U		
Barium	0 16	0 0038U		1 0
Dissolved Barium	0 16	0 0038U		
Calcium	74 9	0 12	99	NS
Dissolved Calcium	74 8	0 11	99	
Chromium	0 002U	0 0025	--	0 05
Dissolved Chromium	0 0036	0 0021	42	
Copper	0 0040	0 0023U		0 2
Dissolved Copper	0 0048	0 0023U		
Iron	0 099	0 065	34	0 3
Dissolved Iron	0 037	0 50	--	
Lead	0 0008U	0 0024	--	0 05
Dissolved Lead	0 0008U	0 12	--	
Lithium	0 01	0 002U		2 5
Dissolved Lithium	0 013	0 002U		
Magnesium	18	0 084	99	NS
Dissolved Magnesium	18	0 057	99	
Manganese	0 0015	0 0015	0	0 05
Dissolved Manganese	0 0019	0 0015U		
Molybdenum	0 0035U	0 0035U	--	0 1
Dissolved Molybdenum	0 0036	0 0035U	--	
Potassium	7 1	4 0	44	NS

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 7
Effluent = Sampling Port 18
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-11

ANALYTICAL RESULTS FOR THE ION-EXCHANGE SYSTEM
(Concluded)

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal	ARAR (mg/L)
Metals and Inorganics				
Dissolved Potassium	3 0	1 1	63	
Selenium	0 014	0 0008U		0 01
Dissolved Selenium	0 013	0 0008U		
Silicon	7 0	6 5	7	NS
Dissolved Silicon	7 1	6 0	15	
Sodium	64 6	16 4	74	NS
Dissolved Sodium	65	15 1	77	
Strontium	0 57	0 0033U		NS
Dissolved Strontium	0 57	0 0033U		
Vanadium	0 0035U	0 0035U	--	0 1
Dissolved Vanadium	0 0042	0 0035U		
Zinc	0 043	0 0058	87	2 0
Dissolved Zinc	0 0067	0 0048	28	
Miscellaneous				
Bicarbonate	184	10 0U		NS
Carbonate	10 0U	10 0U	--	NS
Chloride	142	19 2	86	250
Fluoride	0 86	0 67	22	NS
Nitrate/Nitrite	7 7	55 1	--	10 0
Sulfate	48 5	5 0U		250
Total Dissolved Solids	464	70	85	400
Total Suspended Solids	5 5	5 0U		NS

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 7
Effluent = Sampling Port 18
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-12

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 1

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Aluminum	0 029U	0 029U	--
Dissolved Aluminum	0 029U	0 034	--
Arsenic	0 0029	0 0007U	
Dissolved Arsenic	0 0022	0 0007U	
Banum	0 16	0 16	--
Dissolved Banum	0 16	0 11	31
Calcium	74 9	73 1	2
Dissolved Calcium	74 8	51 6	31
Chromium	0 002U	0 002U	--
Dissolved Chromium	0 0036	0 0027	25
Copper	0 0040	0 0023U	
Dissolved Copper	0 0048	0 0027	44
Iron	0 099	0 018U	
Dissolved Iron	0 037	0 025	32
Lead	0 0008U	0 0008U	--
Dissolved Lead	0 0008U	0 0011	--
Lithium	0 01	0 0098	--
Dissolved Lithium	0 013	0 0084	35
Magnesium	18	17 4	3
Dissolved Magnesium	18 0	12.3	32
Manganese	0 0015	0 0015U	--
Dissolved Manganese	0 0019	0 0032	--
Molybdenum	0 0035U	0 0035U	--
Dissolved Molybdenum	0 0036	0 0035U	--
Potassium	7 1	3 3	54
Dissolved Potassium	3 0	4 2	--

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 7
Effluent = Sampling Port 8
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-12

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 1
(Concluded)

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Selenium	0 014	0 0016	89
Dissolved Selenium	0 013	0 0008U	
Silicon	7 0	6 7	4
Dissolved Silicon	7 1	7 7	—
Sodium	64 6	62.3	4
Dissolved Sodium	65	48 7	25
Strontium	0 57	0 55	4
Dissolved Strontium	0 57	0 39	32
Vanadium	0 0035U	0 0035U	—
Dissolved Vanadium	0 0042	0 0035U	
Zinc	0 043	0 018	58
Dissolved Zinc	0 0067	0 062	—
Miscellaneous			
Bicarbonate	184	96 5	48
Carbonate	10 0U	10 0U	—
Chloride	142	198	—
Fluoride	0 86	0 86	—
Nitrate/Nitrite	7 7	2.5	68
Sulfate	48 5	5 0U	
Total Dissolved Solids	464	692	—
Total Susp Solids	5 5	5 0U	

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 7
Effluent = Sampling Port 8
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-13

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 2

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Aluminum	0 029U	0 029U	--
Dissolved Aluminum	0 034	0 029U	--
Arsenic	0 0007U	0 0009	--
Dissolved Arsenic	0 0007U	0 0007U	--
Barium	0 16	0 029	82
Dissolved Barium	0 16	0 024	85
Calcium	73 1	33 9	54
Dissolved Calcium	51 6	32.4	37
Chromium	0 002U	0 002U	--
Dissolved Chromium	0 0027	0 002	26
Copper	0 0023U	0 0023U	--
Dissolved Copper	0 0027	0 0023U	--
Iron	0 018U	0 033	--
Dissolved Iron	0 025	0 038	--
Lead	0 0008U	0 0014	--
Dissolved Lead	0 0011	0 0008U	--
Lithium	0 0098	0 01	--
Dissolved Lithium	0 0084	0 0085	--
Magnesium	17 4	15 5	11
Dissolved Magnesium	12 3	15 3	--
Manganese	0 0015U	0 0015U	--
Dissolved Manganese	0 0032	0 0015	--
Molybdenum	0 0035U	0 0035U	--
Dissolved Molybdenum	0 0035U	0 0035U	--
Potassium	3 3	3 6	--
Dissolved Potassium	4 2	2.4	43

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 8
Effluent = Sampling Port 9
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-13

ANALYTICAL RESULTS FOR ION EXCHANGE COLUMN NO 2
(Concluded)

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Selenium	0 0016	0 0018	--
Dissolved Selenium	0 0008U	0 0008U	--
Silicon	6 7	7 0	--
Dissolved Silicon	7 7	6 7	13
Sodium	62.3	66 2	--
Dissolved Sodium	48 7	64 4	--
Strontium	0 55	0 25	55
Dissolved Strontium	0 39	0 23	41
Vanadium	0 0035U	0 0035U	--
Dissolved Vanadium	0 0035U	0 0035U	--
Zinc	0 018	0 0041	77
Dissolved Zinc	0 062	0 0056	91
Miscellaneous			
Bicarbonate	96 5	10 0U	
Carbonate	10 0U	10 0U	--
Chloride	198	199	--
Fluoride	0 86	0 82	5
Nitrate/Nitrite	2.5	2.0	20
Sulfate	5 0	5 0U	--
Total Dissolved Solids	692	512	26
Total Suspended Solids	5 0	5 0U	--

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 8
Effluent = Sampling Port 9
U = Analyte not detected the detection limit is shown on the left.

TABLE 3-14

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 3

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Aluminum	0 029U	0 029U	--
Dissolved Aluminum	0 029U	0 068	--
Arsenic	0 0007U	0 0007U	--
Dissolved Arsenic	0 0007U	0 0007U	--
Barium	0 026	0 0038U	
Dissolved Barium	0 024	0 0038U	
Calcium	34 1	0 07	99
Dissolved Calcium	33 9	0 1	99
Chromium	0 002U	0 002U	--
Dissolved Chromium	0 002	0 002U	--
Copper	0 0023U	0 0023U	--
Dissolved Copper	0 0023U	0 0023U	--
Iron	0 04	0 021	48
Dissolved Iron	0 025	0 078	--
Lead	0 0014	0 0008	
Dissolved Lead	0 038	0 036	5
Lithium	0 011	0 002U	
Dissolved Lithium	0 011	0 002U	
Magnesium	15 5	0 033U	
Dissolved Magnesium	15 4	0 033U	
Manganese	0 0015U	0 0015U	--
Dissolved Manganese	0 0019	0 0015U	
Molybdenum	0 0035U	0 0035U	--
Dissolved Molybdenum	0 0035U	0 0035U	--
Potassium	6 6	3 4	48

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 11
Effluent = Sampling Port 12
U = Analyte not detected the detection limit is show on the left.

TABLE 3-14

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 3
(Concluded)

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Dissolved Potassium	3 5	2.6	26
Selenium	0 0009	0 0008U	
Dissolved Selenium	0 0008U	0 0019	--
Silicon	6 9	6 9	--
Dissolved Silicon	7 0	6 4	9
Sodium	66 0	13 7	79
Dissolved Sodium	65 6	13 7	79
Strontium	0 25	0 0033U	
Dissolved Strontium	0 25	0 0033U	
Vanadium	0 0035U	0 0035U	--
Dissolved Vanadium	0 0035U	0 0035U	--
Zinc	0 0053U	0 0048	9
Dissolved Zinc	0 0055	0 0075	--
Miscellaneous			
Bicarbonate	10 0U	10 0U	--
Carbonate	10 0U	10 0U	--
Chloride	257	248	4
Fluoride	0 86	0 82	5
Nitrate/Nitrite	1 9	1 6	16
Sulfate	5 0U	5 0U	--
Total Dissolved Solids	530	62	88
Total Suspended Solids	5 0U	5 0U	--

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 11
Effluent = Sampling Port 12
U = Analyte not detected the detection limit is show on the left.

TABLE 3-15

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 4

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Aluminum	0 029U	0 029U	--
Dissolved Aluminum	0 068	0 029U	--
Arsenic	0 0007U	0 0007U	--
Dissolved Arsenic	0 0007U	0 0007U	--
Barium	0 0038U	0 0038U	--
Dissolved Barium	0 0038U	0 0038U	--
Calcium	0 07	0 12	--
Dissolved Calcium	0 10	0 11	--
Chromium	0 002U	0 0025	--
Dissolved Chromium	0 002U	0 0021	--
Copper	0 0023U	0 0023U	--
Dissolved Copper	0 0023U	0 0023U	--
Iron	0 021	0 065	--
Dissolved Iron	0 078	0 5	--
Lead	0 0008U	0 0024	--
Dissolved Lead	0 036	0 12	--
Lithium	0 002U	0 002U	--
Dissolved Lithium	0 002U	0 002U	--
Magnesium	0 033U	0 084	--
Dissolved Magnesium	0 033U	0 057	--
Manganese	0 0015U	0 0015	--
Dissolved Manganese	0 0015U	0 0015U	--
Molybdenum	0 0035U	0 0035U	--
Dissolved Molybdenum	0 0035U	0 0035U	--
Potassium	3 4	4 0	--
Dissolved Potassium	2 6	1 1	58

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 12
 Effluent = Sampling Port 18
 U = Analyte not detected the detection limit is shown on the left.

TABLE 3-15

ANALYTICAL RESULTS FOR ION-EXCHANGE COLUMN NO 4
(Concluded)

Analyte	Influent Concentration (mg/L)	Effluent Concentration (mg/L)	Percent Removal
Metals and Inorganics			
Selenium	0 0008U	0 0008U	--
Dissolved Selenium	0 0019	0 0008U	--
Silicon	6 9	6 5	6
Dissolved Silicon	6 4	6 0	6
Sodium	13 7	16 4	--
Dissolved Sodium	13 7	15 1	--
Strontium	0 0033U	0 0033U	--
Dissolved Strontium	0 0033U	0 0033U	--
Vanadium	0 0035U	0 0035U	--
Dissolved Vanadium	0 0035U	0 0035U	--
Zinc	0 0048	0 0058	--
Dissolved Zinc	0 0075	0 0048	36
Miscellaneous			
Bicarbonate	10 0U	10 0U	--
Carbonate	10 0U	10 0U	--
Chloride	248	19 2	92
Fluoride	0 82	0 67	18
Nitrate/Nitrite	1 6	55 1	--
Sulfate	5 0U	5 0U	--
Total Dissolved Solids	62	70	--
Total Susp Solids	5 0U	5 0U	--

Analyte reduced below detection limits exact percent removal cannot be calculated

Notes Influent = Sampling Port 12
Effluent = Sampling Port 18
U = Analyte not detected the detection limit is shown on the left.

3 1 3 2 Radionuclide Removal

Radionuclide removal efficiency was tested on June 9 and July 22, 1992 at a flow rate of 30 gallons per minute (gpm). Radionuclide concentrations of ion exchange column No. 1 influent and effluent are shown in Tables 3-16 and 3-17. No radionuclide concentrations exceeded specified ARAR limits. The column was very effective for uranium-234, 235, and 238 removal, reducing these concentrations by more than 90 percent during each trial. Because the uranium isotopes are strong alpha emitters, a corresponding drop in levels of gross alpha activity is expected; this was only observed during trial 2. Levels of gross beta activity were only slightly reduced during each trial; this is likely the result of the presence of hydrogen-3 (tritium) and strontium-90, both beta-emitters, in the treatment water (Table 3-17). Neither radionuclide was substantially removed by the column. However, they were already below ARARs. Samples collected during trial 1 (Table 3-16) were not analyzed for hydrogen-3 and strontium-90. Concentrations of plutonium (236, 238, and 239) were well below ARARs and very near detection limits during each trial; given the error margins associated with these values, it is likely that their reported presence is attributable more to experimental error than to actual groundwater contamination.

3 1 4 Air Sampling

Air sampling was conducted from June 10 to 11, 1992, to determine if VOCs were released during the operation of the treatment facility. Sampling protocol was in compliance with EPA method TO-14. Samples were collected at three locations: (1) the west vent of the surge tank located outside the treatment plant (sampling point 6 on Figure 1-2), (2) the effluent vent of the degasifier located inside the treatment plant (sampling point 10 on Figure 1-2), and (3) a background location inside the treatment plant. Flow controllers were used to collect time-weighted samples. VOC concentrations in the air samples are shown in Tables 3-18 and 3-19. Concentrations of ethylbenzene, 1,3-dimethylbenzene, 1,2-dimethylbenzene, and toluene were high in the vent samples compared to the background samples; concentrations of other VOCs were largely below detection limits. Because the VOCs detected in the air samples were not detected in the influent water, it is suspected that they were released by the plastic piping systems, tank linings, or resins within the

TABLE 3-16

ANALYTICAL RESULTS FOR RADIONUCLIDE REMOVAL TEST OF ION-EXCHANGE
COLUMN NO 1
JUNE 9 1992

Analyte	Influent Concentration (pCi/L)	Effluent Concentration (pCi/L)	ARAR Value (pCi/L)
Americium 241	ND	ND	4
Americium 243	ND	ND	NS
Plutonium 236	ND	0 008 ± 0 008	NS
Plutonium 238	0 028 ± 0 026	0 032 ± 0 013	
Plutonium 239	0 009 ± 0 008	ND	
Plutonium-242	ND	ND	15 (Pu-238 239 240)
Uranium 232	ND	ND	NS
Uranium 234	3 649 ± 0 379	ND	
Uranium 235	0 477 ± 0 088	0 006 ± 0 012	
Uranium 238	2 749 ± 0 293	0 004 ± 0 010	40 (total uranium)
Gross Alpha	2 07 ^b	3 16 ^b	15
Gross Beta	40 4 ^b	29 73 ^b	50

Reported value ± 2 sigma error

^bError not reported

Notes Influent = Sampling Port 7
 Effluent = Sampling Port 8
 ND = Analyte not detected

TABLE 3-17

ANALYTICAL RESULTS FOR RADIONUCLIDE REMOVAL TEST OF ION EXCHANGE
COLUMN NO 1
JULY 22, 1992

Analyte	Influent Concentration (pCi/L)	Effluent Concentration (pCi/L)	ARAR Value (pCi/L)
Americium 241	ND	ND	4
Americium 243	ND	ND	NS
Hydrogen-3	219 82 ^b	161 71 ^b	20 000
Plutonium 236	0 002 ± 0 004	0 004 ± 0 005	NS
Plutonium 238	0 00078 ± 0 006	0 005 ± 0 006	—
Plutonium 239	0 00006 ± 0 006	0 001 ± 0 005	15 (Pu 238 239 240)
Plutonium 242	ND	ND	NS
Strontium 90	0 07 ^b	0 2 ^b	8
Uranium 232	ND	ND	—
Uranium 234	3 992 ± 0 323	0 035 ± 0 011	—
Uranium 235	0 209 ± 0 043	0 015 ± 0 008	—
Uranium 238	2 89 ± 0 241	0 015 ± 0 007	40 (total uranium)
Gross Alpha	1 95 ^b	0 2 ^b	15
Gross Beta	37 06 ^b	24 62 ^b	50

Report value ±2 sigma error

^bError not reported

Notes Influent = Sampling Port 7
 Effluent = Sampling Port 8
 ND = Analyte not detected

TABLE 3-18

VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN BACKGROUND AND SYSTEM
AIR SAMPLES JUNE 10 1992

Analyte	Background Sample Concentration (ppb)	Degas Stack Concentration (ppb)	Surge Tank Vent Concentration (ppb)
Ethylbenzene	3 U	220	510
Styrene	1 4 J	6 U	6 U
1 3-Dimethylbenzene	10	6 U	2,300
Toluene	4 4	88	29
Tetrachloroethene	2 U	6 U	5 1 J
Chloroform	3 U	6 8 J	6 6 J
1 1 1 Trichloroethane	5 4	4 5 JB	11
Trichloroethene	2 U	6 U	4 J
1 2 Dimethylbenzene	3 8	6 U	840
1 2 4-Trimethylbenzene	9 4 J	6 U	6 U

Notes

J = Estimated value

U = Analyte not detected

B = Analyte detected in associated blank as well as sample

Compounds not detected in any samples

cis-1 3-Dichloropropene
trans-1 3-Dichloropropene
1 4-Dichlorobenzene
1 2-Dibromoethane
1,2 Dichloroethane
1 3 5-Trimethylbenzene
Chlorobenzene
1,2 4-Trichlorobenzene
cis-1,2-Dichloroethene
1 3-Dichlorobenzene

Carbon Tetrachloride
Benzene
Vinyl chloride
1 1-Dichloroethane
1,2-Dichloropropane
1 1,2 Trichloroethane
1 1,2,2 Tetrachloroethane
Hexachlorobutadiene
1,2-Dichlorobenzene

TABLE 3-19

VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN BACKGROUND AND SYSTEM
AIR SAMPLES JUNE 11 1992

Analyte	Background Sample Concentration (µg/L)	Degas Stack Concentration (µg/L)	Surge Tank Vent Concentration (µg/L)
Ethylbenzene	1 6	77	280
1 3 Dimethylbenzene	7 7	470	700
Toluene	2.7	49	33
Tetrachloroethene	1 U	6 U	2.4 J
Chloroform	2 U	4 1 J	3 7 J
1 1 1 Trichloroethane	6 4 B	9 3 B	12 B
1 2 Dimethylbenzene	2.9	210	280
1 2 4- Trimethylbenzene	1 4 J	6 U	6 U

Notes J = Estimated value
U = Analyte not detected
B = Analyte detected in associated blank as well as sample

Compounds not detected in any samples

Styrene	1 3-Dichlorobenzene
cis-1 3-Dichloropropene	Carbon Tetrachloride
trans-1 3-Dichloropropene	Benzene
1 4-Dichlorobenzene	Vinyl chloride
1 2 Dibromoethane	1 1 Dichloroethane
1 2 Dichloroethane	1,2 Dichloropropane
1 3 5-Trimethylbenzene	1 1,2 Trichloroethane
Chlorobenzene	Trichloroethene
1 2 4-Trichlorobenzene	1 1,2,2 Tetrachloroethane
cis-1 2 Dichloroethene	Hexachlorobutadiene
	1,2 Dichlorobenzene

treatment system Further testing will be performed to verify they were associated with startup conditions

In addition the absence of VOCs associated with the influent groundwater suggests that stripping (as opposed to oxidation) did not occur

3 2 SYSTEMS OPERATION

During operation of the groundwater collection storage and treatment systems some equipment failures occurred and other observations were made such that the operation may be made more reliable through minor modification

3 2 1 UV Secondary Electrical Protection

The UV unit contains a high voltage ballast and capacitor for each of the 16 lamps These are located in two air-cooled panels A shunt trip is installed on the primary side of the ballasts in each panel so that if arcing would occur in the panel the UV unit would be automatically de-energized However a similar shunt was not installed on the secondary (lamp) side On one occasion a lamp wire shorted and arced in the panel The operator manually turned the unit off to prevent damage A shunt installed in the secondary lamp circuit would prevent such an occurrence

3 2 2 UV Panel Cooling

Cooling fans are installed in each UV ballast panel to move air through the panel and around the ballasts to prevent overheating During UV operation the lamp supply ballast temperature rises to about 110°F In spite of the fans localized temperatures in the ballast panels may become excessive and exceed 180°F The manufacturer has recommended either relocating the existing fans or installing an internal pancake fan to increase air circulation

3 2 3 Peroxide Dose

Testing included operation of the UV system at peroxide doses of 35 and 50 mg/L. Organic removal was achieved at both concentrations. It may be possible to further reduce the dosage while maintaining complete removal of the organics. Reducing it by 10 mg/L would result in a savings of about \$0.94 per day. It would probably not be cost effective to conduct a study for this purpose.

3 2 4 Influent Suspended Solids

The influent water from the french drain contains few suspended solids. Therefore the UV treatment system contains no provision for removing suspended solids. However two conditions may exist and have been noted occasionally when influent suspended solids may become significant.

Water from the french drain may contain solids if pumping is continued until the low level switch stops the pump. The low water condition causes silt to be drawn from the french drain and sump.

Influent to the UV unit also includes water from the Building 891 sump. From time to time and especially during wet weather soil is brought into the building on shoes or equipment. This material may get washed to the sump and then be pumped to the influent tanks. Any solids in the influent tanks eventually exit the tanks and are carried to the UV reactors and downstream units. Provision needs to be made to remove the solids ahead of the UV supply pumps to prevent deposition in the treatment system. A cartridge filter would provide the needed protection.

A basket strainer has been installed in this line to remove material larger than 3/8 inch to protect the pumps.

3 2 5 Ion Exchange Effect on pH

During startup and operation of the treatment facility the pH after IX treatment was observed to vary from more than pH 9.0 immediately following regeneration to approximately 2.5 after several

thousand gallons were treated. Because there is no provision to adjust pH after treatment, the IX resins would be regenerated when pH decreased to about 6.0, although the resins were still efficiently removing the inorganics and metals as required.

The original design basis had included a provision to split the flow after the second IX column, with part of the flow to be passed through a column of activated alumina. This concept was recommended in the Interim Remedial Action Plan (IRA) for the OU1 881 Hillside Area (Rockwell 1989). Its purpose would be to remove manganese or selenium (if present) and reduce the volume of IX regenerant. The flow schematic was changed in the Basis of Design Report for Ion Exchange System 881 Hillside Remedial Actions (ESI 1989). The system was constructed to treat all of the water through the four IX columns. It may be possible to provide better pH control and still maintain the required inorganic removal by replacing one or more of the resins with other more selective resins. Splitting the flow after the second IX column and then recombining the two streams at the final effluent may also be useful for providing better pH control. A study of alternative resins and flow schematics would determine whether such considerations could be used effectively.

3.2.6 Ion Exchange Basis of Design

The ion exchange basis of design (ESI 1989) recommended an alumina column after ion exchange column No. 2 as described above. Based upon the results presented in Section 3.0, selenium is adequately removed in ion exchange column No. 1. Therefore, an alumina column is not necessary.

3.2.7 Radionuclide Analysis

The present procedure for measuring radionuclides in the treated water is to collect a sample from a full effluent storage tank and send it to a laboratory for analysis. Laboratory analysis for radionuclides is time consuming and results are reported long after the other analyses are received. To facilitate treatment plant operations, a gamma spectrometer installed at the treatment system would be useful to provide a rapid response and facilitate treated effluent disposal without storage.

3 2 8 Hydrogen Peroxide Injection

Before H_2O_2 is injected into the UV reactors it is diluted with treatment effluent water from the UV system. A centrifugal pump (splitter pump) is installed at the UV outlet to mix and pump the diluted H_2O_2 to any of three injection ports at the reactors. Because of the location and position of the pump suction piping the required flooded suction is difficult to maintain. Currently the surge tank inlet valve is kept in a partly closed position so that the UV outlet pressure can be maintained at about 5 psi. This procedure is not recommended because if the pressure increases significantly the UV reactor pressure will cause the overpressure rupture disc to fail. This condition can be corrected by relocating the UV reactor outlet piping to make sure the pipe is always full of water thus assuring a flooded pump suction.

3 2 9 French Drain Water Level

The initial operating instructions for the french drain do not discuss the desired water level for normal operation. In general the level has been maintained near the lower pumping limit so that the french drain and surrounding soils contain little free water. A current concern is that maintaining a very low level may actually reduce the total amount of water that can be recovered and it may also contribute to pumping more suspended solids in the form of silt to the treatment system. For best operation the pump controls should be set to turn off the pumps when the level drops to near the mid point elevation of the french drain.

3 2 10 881 Footing Drain

As previously stated the treatment system influent contaminant concentrations are less than anticipated. The 881 footing drain is not expected to contain metals or radionuclides above ARARs (DOE 1990). Therefore this water may be suitable for discharge directly to the South Interceptor Ditch (SID) without treatment. Additional analyses should be conducted to verify if the stream meets ARARs before treatment.

3 2.11 Presence of Iron

There has been concern that iron may be present in sufficient quantity in the influent to precipitate on the quartz tubes or to reduce the efficiency of the UV/H₂O₂ process. Although iron is present in the influent at very low concentrations, it has not adversely affected the UV/H₂O₂ process.

While the iron did not interfere with the UV/H₂O₂ system, a red slime collected in the bag filter at the IX system when water was recirculated from effluent tank T 206. Samples were collected from the ion exchange system. Iron was detected but below ARARs. The data are inconclusive on whether iron is interfering with the ion exchange system.

3 2.12 Acid and Caustic Pumps

There was some initial concern that the acid and caustic metering pumps suction may not remain flooded because of their placement with respect to the acid and caustic tanks. The caustic tank has been pumped down to within 1 1/2 feet of the bottom and the caustic metering pump suction remained flooded. The caustic is more viscous and difficult to pump than the acid. Therefore, since the caustic system has operated without a problem, the acid system is also anticipated to operate without any problems. However, the tanks should not be completely emptied. This will help avoid the situation of the pumps losing their prime.

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TITLE Conclusions and Recommendations

Approved By

Name

(Date)

MC Burmester 11/1/20/92

4 0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this section is to present the conclusions derived from operating and testing the system. It also provides recommendations for improved treatment system operation.

4 1 CONCLUSIONS

4 1 1 Characterization

The influent from the french drain and the Building 881 sump consistently contained the following parameters:

Organics--tetrachloroethene and trichloroethene

Radionuclides--uranium-234 235 238 hydrogen-3 (tritium) gross alpha, and gross beta

Inorganics--arsenic barium calcium copper iron lithium magnesium potassium selenium sodium strontium zinc bicarbonate chloride fluoride nitrate sulfate and total dissolved solids

During the systems operation testing (refer to Tables 3-3 3-4 3-5 3-6 3-7 3-10 3-11 3-16 and 3-17) only four contaminants were detected above ARAR concentrations: tetrachloroethene, trichloroethene, selenium, and total dissolved solids. The high levels of 1,1-dichloroethane, 1,1,1-trichloroethane, and 2-butanone shown in Table 3-1 were observed in only one sample out of approximately 100 taken during the course of this study.

A more detailed discussion of the influent is presented in Section 3.0 of this document.

4.1.2 Systems Evaluation

This section presents a summary of the treatment system's effectiveness.

The results presented in Section 3.0 of this document demonstrate that the system treats OU 1 groundwater to acceptable discharge requirements.

The UV/H₂O₂ treatment unit successfully removed the organics present in the influent. Tetrachloroethene and trichloroethene were both removed through oxidation, not stripping, to ARAR limits. At 30 gpm, the UV/H₂O₂ system achieved these removals at a hydrogen peroxide dose of 50 mg/L and 8 UV lamps. At 15 gpm, the UV/H₂O₂ system achieved these removals at a peroxide dose of 35 mg/L and with 16 lamps.

Most metal concentrations were below discharge limits in the influent. Those that were above discharge limits were effectively removed by ion exchange column No. 1. Total dissolved solids were effectively removed by ion exchange column No. 3, as designed.

Based on the results from one test, the ion exchange system was successful in removing radionuclides and inorganics. The following inorganics were removed by at least 70 percent and well below discharge limits:

Calcium

Magnesium

Sodium

Zinc

Chloride

Total dissolved solids

Additionally the following inorganics were removed to below detection limits

Arsenic

Barium

Copper

Lithium

Selenium

Strontium

Total suspended solids

Bicarbonate

Sulfate

Uranium 234 235 and 238 were effectively removed by the ion exchange system Gross alpha results also indicated a reduction in radionuclides

A discussion of the testing results is presented in Section 3 0

4 2 RECOMMENDATIONS

The following are recommendations for improving the operation of the UV/H₂O₂ and ion exchange treatment system

- 1 Consider a direct discharge of the treated effluent to the SID bypassing the effluent storage tanks and eliminating double treatment of the groundwater This recommendation is made because the tank coating contains residual organics that may migrate to the stored water An online analyzer would verify the treated effluent meets discharge requirements
2. Install a shunt trip on the secondary side of the UV/H₂O₂ system ballast so that the system would automatically shut down in the event that arcing occurs in the secondary lamp circuit.

- 3 Improve the cooling in the UV/H₂O₂ system ballast enclosures to prolong service life of ballasts and capacitors. The cooling could be achieved by installing internal fans or relocating the existing fans.
- 4 Install a cartridge filter on the inlet side of the UV/H₂O₂ system feed pumps to remove solids.
- 5 Evaluate resins to eliminate pH swings.
- 6 Consider converting ion exchange column No. 1 to a regenerable column.
- 7 Install a gamma spectrometer analyzer in the ion exchange system effluent line for online analysis.
- 8 Install a gas chromatograph for online measurement of VOCs at the treatment system effluent.
- 9 Modify the UV system discharge piping to maintain a constant and reliable flooded suction at the peroxide splitter pump inlet.
- 10 The french drain water level should be maintained at an intermediate level to avoid impacting groundwater recovery and possible silt transport.
- 11 It may be possible to split the flow after ion exchange column No. 2 to minimize pH variation while maintaining effluent quality to meet ARARs and reducing the ion exchange regenerant. A study of flow splitters and alternative IX resins should be conducted to evaluate these possibilities.
- 12 Conduct additional analyses on the 881 footing drain stream to confirm that the stream meets ARARs before treatment.

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- 13 Continue evaluation of iron to confirm whether it interferes with the ion exchange process
- 14 Continue monitoring column IX 1 to determine resin effectiveness and radionuclide loading (health and safety concerns)
- 15 During regeneration of the IX 1 resins the acid and caustic pump discharge piping is observed to vibrate Additional pipe support should be placed to protect the piping from vibration damage

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5 0 REFERENCES

DOE 1990 United States Department of Energy *Interim Measure/Interim Remedial Action Plan for the 881 Hillside Area*. Rocky Flats Plant, Golden Colorado January 1990

EG&G 1992. EG&G Final Work Plan Manual for the Startup Operation and Maintenance of the IM/IRA for the 881 Hillside Operable Unit 1 Rocky Flats Plant. Golden Colorado Prepared for the United States Department of Energy February 1992

ESI 1989 Engineering Science Inc *Basis of Design Report for Ion Exchange System OU1 881 Hillside Remedial Action* Rocky Flats Plant Golden Colorado Prepared for the United States Department of Energy December 1989

Rockwell 1989 Rockwell International *Interim Remedial Action Plan for the 881 Hillside Area* Rocky Flats Plant Golden Colorado Prepared for the United States Department of Energy 1989

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Appendix A

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TITLE Data Summaries

Approved By

MC Burmeister 11/20/92
Name (Date)

Appendix A. DATA SUMMARIES

Data summaries are presented in a series of four tables on the following pages

The following notes or data qualifiers (Q) are used to describe laboratory results in Tables A-3 A-4 and A 5 The Q will be listed at the top of each column containing the following qualifiers

U = Analyte not detected The instrument detection limit is shown on the left (for example 0 0006U)

B = Analyte detected in associated blank as well as in sample

N = Spiked sample recovery not within control limits

W = Post-digestion spike for furnace AA analysis is out of control limits (85 to 115 percent) while sample absorbance is less than 50 percent of spike absorbance

J = Indicates an estimated value for either a TIC or an analyte that meets the identification criteria but the result is less than the specified detection limit.

BS = Indicates that matrix analyses were conducted on reagent grade water

E = Concentrations exceed the calibration range of the instrument

* = Sample analyzed after holding time was exceeded

TABLE A 1

SAMPLE POINTS AND DESCRIPTIONS FOR TREATMENT SYSTEM

Sample Point	Description
1	Building 881 drain
2	French drain
3	Recovery well
4	UV/peroxide unit influent
5	UV/peroxide unit effluent
6	Ion exchange surge tank
7	Ion exchange Column No 1 influent
8	Ion exchange Column No 1 effluent
9	Ion exchange Column No 2 effluent
10	Degasifier
11	Ion exchange Column No 3 influent
12	Ion exchange Column No 3 effluent
13	Ion exchange Column No 4 effluent
14	Neutralization tank (Tank 210)
15	Regenerant tank (Tank 205)
16	Regenerant tank (Tank 206)
17	Regenerant tank (Tank 207)
18	Ion exchange Column No 4 effluent/recycle line

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION
MARCH 31 THROUGH SEPTEMBER 21 1992.

Sample Number	Sample Date	Sample Point	Sample Use
FT00001ITU1	3/31	4	SOT (VOA)
FT00002ITU1	3/31	7	SOT (VOA/METS/RADS/WQ)
FT00003ITU1	3/31	13	SOT (METS/RADS/WQ)
FT00004ITU1	4/1	4	SOT (VOA)
FT00005ITU1	4/1	5	SOT (VOA)
FT00006ITU1	4/2	1	MISC CHAR
FT00007ITU1	4/2	4	MISC CHAR
FT00008ITU1	4/2	3	CANCELLED
FT00009ITU1	4/6	4	SOT (VOA)
FT00010ITU1	4/6	5	SOT (VOA)
FT00011ITU1	4/6	4	RAD SCREEN
FT00012ITU1	4/7	4	MISC CHAR
FT00013ITU1	4/7	5	CANCELLED
FT00014ITU1	4/7	3	MISC CHAR
FT00015ITU1	4/13	14	MISC CHAR
FT00016ITU1	4/24	16	MISC CHAR
FT00017ITU1	4/29	14	RAD SCREEN
FT00018ITU1	4/30	14	MISC CHAR

Notes	BNA	=	Base/neutral acid (semi-volatile) organics
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics
	WQ	=	Water quality

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION MARCH 31 TO SEPTEMBER 21 1992.
(Continued)

Sample Number	Sample Date	Sample Point	Sample Use
FT00019ITU1	5/4	14	RAD SCREEN
FT00020ITU1	5/4	4	SOT (VOA)
FT00021ITU1	5/4	5	SOT (VOA)
FT00022ITU1	5/4	BLANK	QA/QC
FT00023ITU1	5/4	5	QA/QC
FT00024ITU1	5/4	4	SOT (VOA)
FT00025ITU1	5/4	5	SOT (VOA)
FT00026ITU1	5/6	14	RAD SCREEN
FT00027ITU1	5/11	4	CANCELLED
FT00028ITU1	5/12	4	RAD SCREEN
FT00029ITU1	5/18	14	RAD SCREEN
FT00030ITU1	5/19	4	CANCELLED
FT00031ITU1	5/19	5	CANCELLED
FT00032ITU1	5/19	17	RAD SCREEN
FT00033ITU1	5/25	14	CANCELLED
FT00034ITU1	5/26	14	RAD SCREEN
FT00035ITU1	5/26	16	MISC CHAR
FT00036ITU1	5/21	14	MISC CHAR

Notes	BNA	=	Base/neutral acid (semi-volatile) organics
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics
	WQ	=	Water quality

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION MARCH 31 TO SEPTEMBER 21 1992.
(Continued)

Sample Number	Sample Date	Sample Point	Sample Use
FT00037ITU1	5/29	14	RAD SCREEN
FT00038ITU1	5/29	17	MISC CHAR
FT00039ITU1	6/3	15	RAD SCREEN
FT00040ITU1	6/3	14	RAD SCREEN
FT00041ITU1	6/3	15	RAD SCREEN
FT00042ITU1	6/4	15	MISC CHAR
FT00043ITU1	6/5	15	MISC CHAR
FT00044ITU1	6/4	17	RAD SCREEN
FT00045ITU1	6/8	17	MISC CHAR
FT00046ITU1	6/10	4	SOT (VOA)
FT00047ITU1	6/10	5	SOT (VOA)
FT00048ITU1	6/10	7	SOT (METS/RADS/WQ)
FT00049ITU1	6/10	8	SOT (METS/RADS/WQ)
FT00050ITU1	6/10	9	SOT (METS/RADS/WQ)
FT00051ITU1	6/10	11	SOT (METS/RADS/WQ)
FT00052ITU1	6/10	12	SOT (METS/RADS/WQ)
FT00053ITU1	6/10	18	SOT (METS/RADS/WQ)
FT00054ITU1	6/9	14	CANCELLED

Notes	BNA	=	Base/neutral acid (semi-volatile) organics
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics
	WQ	=	Water quality

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION MARCH 31 TO SEPTEMBER 21 1992
(Continued)

Sample Number	Sample Date	Sample Point	Sample Use
FT00055ITU1	6/9	14	RAD SCREEN
FT00056ITU1	6/10	BLANK	AIR SAMPLE
FT00057ITU1	6/10	AMBIENT AIR	SAMPLE
FT00058ITU1	6/10	10	AIR SAMPLE
FT00059ITU1	6/10	6	AIR SAMPLE
FT00060ITU1	6/11	AMBIENT AIR	SAMPLE
FT00061ITU1	6/11	10	AIR SAMPLE
FT00062ITU1	6/11	6	AIR SAMPLE
FT00063ITU1	6/11	10	AIR SAMPLE
FT00064ITU1	6/12	5	MISC CHAR (REGEN)
FT00065ITU1	6/12	15	MISC CHAR
FT00066ITU1	6/15	14	RAD SCREEN
FT00067ITU1	6/15	14	MISC CHAR
FT00068ITU1	6/15	14	MISC CHAR
FT00069ITU1	6/15	14	MISC CHAR
FT00070ITU1	6/15	14	MISC CHAR
FT00071ITU1	6/17	14	RAD SCREEN
FT00072ITU1			CANCELLED

Notes	BNA	=	Base/neutral acid (semi-volatile) organics
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics.
	WQ	=	Water quality

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION MARCH 31 TO SEPTEMBER 21 1992
(Continued)

Sample Number	Sample Date	Sample Point	Sample Use
FT00073ITU1	6/22	14	RAD SCREEN
FT00074ITU1	6/26	14	RAD SCREEN
FT00075ITU1	7/1	16	MISC CHAR (REGEN)
FT00076ITU1	7/2	14	RAD SCREEN
FT00077ITU1	7/13	16	MISC CHAR
FT00078ITU1	7/13	5	MISC CHAR (REGEN)
FT00079ITU1	7/16	14	RAD SCREEN
FT00080ITU1	7/21	14	RAD SCREEN
FT00081ITU1	7/22	4	SOT (VOA)
FT00082ITU1	7/22	5	SOT (VOA)
FT00083ITU1	7/22	7	SOT (METS/RADS/WQ)
FT00084ITU1	7/22	8	SOT (METS/RADS/WQ)
FT00085ITU1	7/22	11	SOT (METS/RADS/WQ)
FT00086ITU1	7/22	12	SOT (METS/RADS/WQ)
FT00087ITU1	7/22	13	SOT (METS/RADS/WQ)
FT00088ITU1	7/22	1	MISC CHAR
FT00089ITU1	7/24	15	MISC CHAR
FT00090ITU1	7/27	14	RAD SCREEN

Notes	BNA	=	Base/neutral acid (semi-volatile) organics.
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics
	WQ	=	Water quality

TABLE A 2

IDENTIFICATION NUMBERS AND USES OF WATER SAMPLES COLLECTED
DURING TREATMENT SYSTEM OPERATION MARCH 31 TO SEPTEMBER 21 1992
(Continued)

Sample Number	Sample Date	Sample Point	Sample Use
FT00091ITU1	8/3	14	RAD SCREEN
FT00092ITU1	8/15	14	RAD SCREEN
FT00093ITU1	8/19	14	RAD SCREEN
FT00094ITU1	8/25	ALL	SOT (VOA/BN)
FT00095ITU1	8/25	ALL	SOT (VOA/BN)
FT00096ITU1	8/25	ALL	SOT (VOA/BN)
FT00097ITU1	8/25	ALL	SOT (VOA/BN)
FT00098ITU1	8/25	ALL	SOT (VOA/BN)
FT00099ITU1	8/25	4	RAD SCREEN
FT00100ITU1	8/25	14	RAD SCREEN
FT00101ITU1	8/29	14	RAD SCREEN
FT00102ITU1	9/5	14	RAD SCREEN
FT00103ITU1	9/10	16	MISC CHAR
FT00104ITU1	9/11	SID DIS	MISC CHAR
FT00105ITU1	9/18	TANK No 204	MISC CHAR
FT00106ITU1	9/21	1	RAD SCREEN

Notes	BN	=	Base/neutral acid (semi-volatile) organics
	METS	=	Metals
	MISC CHAR	=	Sample not useful for analysis of system efficiency and used only for general characterization of the treatment water
	RAD SCREEN	=	Sample used only for a radionuclide screen
	REGEN	=	System treatment water was a storage tank regenerant.
	SID DIS	=	South Interceptor Ditch discharge
	SOT	=	Sample used for system operation test (parameters measured shown in parentheses)
	VOA	=	Volatile organics
	WQ	=	Water quality

TABLE A-3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION

SAMPLE #	SAMPLE PT	MONT	DAY	YEAR	2 BUTANONE	Q	TETRACHLOROETHENE	Q	ACETONE	Q	1,1-DICHLOROETHENE	Q	1,1,1-TRICHLOROETHANE	Q
					ug/L		ug/L		g/L		g/L		g/L	
FT00001TU1	4	3	31	92		10 U	18.2		10 U			5 U		5 U
FT00002TU1	7	3	31	92		10 U	6 U		10 U			5 U		5 U
FT00003TU1	13	3	31	92		84			10 U			5 U		5 U
FT00004TU1	4	4	1	92		10 U	14.7		10 U			5 U		5 U
FT00005TU1	5	4	1	92		10 U	5 U		54.6			5 U		5 U
FT00006TU1	1	4	2	92		10 U	39		10 U			5 U		5 U
FT00007TU1	4	4	2	92		490	14		10 U			5 U		5 U
FT00008TU1	4	4	6	92		10 U	15		10 U			5 U		5 U
FT00010TU1	5	4	6	92		10 U	5 U		11			5 U		5 U
FT00012TU1	4	4	7	92		10 U	16		10 U			5 U		5 U
FT00014TU1	3	4	7	92		120	35		27			17		18
FT00015TU1	14	5	1	92		610	25 U		19			25 U		25 U
FT00018TU1	16	4	24	92		10 U	5 U		22			5 U		5 U
FT00018TU1	14	4	30	92		56	5 U		7			5 U		5 U
FT00021TU1	5	5	4	92		10 U	5 U		25			5 U		5 U
FT00022TU1	BLANK	5	4	92		10 U	5 U		11			5 U		5 U
FT00023TU1	5	5	4	92		10 U	5 U		30			5 U		5 U
FT00025TU1	5	5	4	92		10 U	5 U		16			5 U		5 U
FT00036TU1	14	5	21	92		10 U	5 U		22			5 U		5 U
FT00037TU1	14	5	29	92		16	5 U		14			5 U		5 U
FT00042TU1	16	6	4	92		10 U	5 U		25			5 U		5 U
FT00043TU1	16	6	5	92		28	5 U		10 U			5 U		5 U
FT00045TU1	17	6	8	92		10 U	5 U		26			5 U		5 U
FT00046TU1	4	6	10	92		10 U	13		10 U			5 U		5 U
FT00047TU1	5	6	10	92		10 U	5 U		10 U			5 U		5 U
FT00048TU1	7	6	10	92		10 U	5 U		19			5 U		5 U
FT00050TU1	8	6	10	92		10 U	5 U		21			5 U		5 U
FT00051TU1	11	6	10	92		10 U	5 U		22			5 U		5 U
FT00053TU1	18	6	10	92		27	5 U		21			8		5 U
FT00064TU1	5	6	12	92		10 U	5 U		47			5 U		5 U

Final

TABLE A 3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	MONT	DAY	YEAR	2	BUTANONE	Q	TETRACHLOROETHENE	Q	ACETONE	Q	1 1 DICHLOROETHENE	Q	1 1 1 TRICHLOROETHANE	Q
						g/L		ug/L		g/L		g/L		g/L	
FT000861TU1	15	8	12	92			10		5 U		10		5 U		5 U
FT000871TU1	14	6	15	92			10 U		6 U		10 U		5 U		5 U
FT000881TU1	14	6	15	92			30		6 U		24		5 U		5 U
FT000891TU1	14	6	15	92			10 U		5 U		10 U		5 U		5 U
FT000771TU1	18	7	13	92			10 U		6 U		8		5 U		5 U
FT000781TU1	5	7	13	92			10 U		5 U		10 U		5 U		5 U
FT000811TU1	4	7	22	92			10 U		12		10 U		5 U		5 U
FT000821TU1	5	7	22	92			10 U		6 U		10 U		5 U		5 U
FT000831TU1	7	7	22	92			10 U		6 U		7		5 U		5 U
FT000841TU1	8	7	22	92			10 U		6 U		10 U		5 U		5 U
FT000851TU1	11	7	22	92			10 U		5 U		10 U		5 U		5 U
FT000861TU1	12	7	22	92			10 U		6 U		10 U		5 U		5 U
FT000871TU1	13	7	22	92			12		6 U		10 U		5 U		5 U
FT000891TU1	15	7	24	92			10 U		5 U		10 U		5 U		5 U
FT000841TU1 4	4	8	25	92			10 U		12		10 U		5 U		5 U
FT000841TU1 5	5	8	25	92			10 U		6 U		10		5 U		5 U
FT000841TU1 7	7	8	25	92			10 U		6 U		7 J		5 U		5 U
FT000941TU1 9	9	8	25	92			10 U		6 U		26		5 U		5 U
FT000841TU1 11	11	8	25	92			10 U		5 U		18		5 U		5 U
FT000841TU1 18	18	8	25	92			10 U		5 U		11		5 U		5 U
FT000951TU1-4	4	8	25	92			10 U		11		10 U		5 U		5 U
FT000951TU1 5	5	8	25	92			10 U		6 U		10 U		5 U		5 U
FT000951TU1 7	7	8	25	92			10 U		5 U		10 U		5 U		5 U
FT000951TU1-9	9	8	25	92			10 U		5 U		10 U		5 U		5 U
FT000951TU1 11	11	8	25	92			10 U		5 U		10 U		5 U		5 U
FT000951TU1 18	18	8	25	92			6 J		5 U		17		5 U		5 U
FT000981TU1-4	4	8	25	92			10 U		11		10 U		5 U		5 U
FT000981TU1 5	5	8	25	92			10 U		6 U		10 U		5 U		5 U
FT000981TU1 7	7	8	25	92			10 U		6 U		10		5 U		5 U
FT000981TU1 9	9	8	25	92			10 U		6 U		10		5 U		5 U
FT000981TU1 11	11	8	25	92			10 U		6 U		11		5 U		5 U

TABLE A 3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	MONTH	DAY	YEAR	2-BUTANONE g/L	TETRACHLOROETHENE ug/L	Q	ACETONE g/L	Q	1,1 DICHLOROETHENE g/L	Q	1,1,1 TRICHLOROETHANE g/L	Q
FT000981TU1 18	18	8	25	92	10 U		5 U	11			5 U		5 U
FT000971TU1 4	4	8	25	92	10 U		11	10 U			5 U		5 U
FT000971TU1 5	5	8	25	92	10 U		5 U	5 BJ			5 U		5 U
FT000971TU1 7	7	8	25	92	10 U		5 U	6 BJ			5 U		5 U
FT000971TU1 9	9	8	25	92	10 U		5 U	7 BJ			5 U		5 U
FT000971TU1 11	11	8	25	92	10 U		5 U	6 BJ			5 U		5 U
FT000971TU1 18	18	8	25	92	10 U		5 U	7 BJ			5 U		5 U
FT000981TU1 1	1	8	25	92	10 U		8	10 U			5 U		5 U
FT000981TU1 2	2	8	25	92	10 U		12	10 U			5 U		5 U
FT001031TU1	17	9	10	92	10 U		5 U	22			5 U		5 U
FT001041TU1	SID	9	11	92	10 U		5 U	10 U			5 U		5 U

TABLE A-3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	TRICHLOROETHENE g/L	TOLUENE ug/L	1,2-DICHLOROPROPANE ug/L	ETHYLBENZENE ug/L	XYLENE g/L	CHLOROFORM g/L	Q
FT00001TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	57
FT00002TU1	7	5 U	5 U	5 U	91	362	71	71
FT00003TU1	13	5 U	41	895	5 U	5 U	119	119
FT00004TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00005TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00006TU1	1	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00007TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00008TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00009TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00010TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00011TU1	4	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00012TU1	3	210	20	5 U	5 U	5 U	5 U	5 U
FT00013TU1	14	25 U	8	7	25 U	6	7	7
FT00014TU1	16	5 U	8	7	29	91	5 U	5 U
FT00015TU1	14	5 U	4	5 U	5 U	3	5	5
FT00016TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00017TU1	BLANK	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00018TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00019TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00020TU1	14	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00021TU1	14	5 U	3	5 U	5 U	5 U	5 U	5 U
FT00022TU1	16	5 U	5 U	5 U	100	530	4	4
FT00023TU1	16	5 U	8	5 U	5 U	1	5 U	5 U
FT00024TU1	17	5 U	5 U	5 U	37	230	10	10
FT00025TU1	4	8	5 U	5 U	5 U	5 U	5 U	5 U
FT00026TU1	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00027TU1	7	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00028TU1	9	5 U	5 U	5 U	18	71	5 U	5 U
FT00029TU1	11	5 U	5 U	5 U	5 U	5 U	5 U	5 U
FT00030TU1	18	5 U	8	5 U	1	5	8	8
FT00031TU1	5	5 U	5 U	5 U	3	3	5 U	5 U

TABLE A-3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

[illegible]

TABLE A-3

SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	TRICHLOROETHENE	Q	TOLUENE	Q	1,2-DICHLOROPROPANE	Q	ETHYLBENZENE	Q	XYLENE	Q	CHLOROFORM	Q
		g/L		ug/L		ug/L		g/L		g/L		ug/L	
FT000981TU1 18	18		5 U		12		5 U		3 J		20		4 J
FT000971TU1 4	4		16		5 U		5 U		5 U		5 U		5 U
FT000971TU1 5	5		5 U		5 U		5 U		5 U		5 U		5 U
FT000971TU1 7	7		5 U		5 U		5 U		5 U		7		5 U
FT000971TU1 9	9		5 U		9		5 U		3 J		16		5 U
FT000971TU1 11	11		5 U		5 U		5 U		5 U		1 J		5 U
FT000971TU1 18	18		5 U		9		5 U		2 J		14		3 J
FT000981TU1 1	1		5 U		5 U		5 U		5 U		5 U		5 U
FT000981TU1 2	2		1 J		5 U		5 U		5 U		5 U		5 U
FT001031TU1	17		5 U		5 U		5 U		6		27		2
FT001041TU1	SID		5 U		5 U		5 U		5 U		5 U		5 U

TABLE A-3

SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	STYRENE	Q	4-METHYL 2 PENTANONE	Q	METHYLENE CHLORIDE	Q
FT000011TU1	4	5 U		10 U		3 4	
FT000021TU1	7	5 U		110 9		4 1	
FT000031TU1	13	5 U		76 9		3 3	
FT000041TU1	4	5 U		10 U		4 1	
FT000051TU1	5	5 U		10 U		3 7	
FT000061TU1	1	5 U		10 U		5 U	
FT000071TU1	4	5 U		10 U		5 U	
FT000081TU1	4	5 U		10 U		5 U	
FT000091TU1	4	5 U		10 U		5 U	
FT000101TU1	5	5 U		10 U		5 U	
FT000121TU1	4	5 U		10 U		5 U	
FT000141TU1	3	5 U		10 U		5 U	
FT000161TU1	14	15		47		18	
FT000181TU1	16	5 U		10 U		5 U	
FT000181TU1	14	6		17		4	
FT000211TU1	5	5 U		10 U		5 U	
FT000221TU1	BLANK	5 U		10 U		5 U	
FT000231TU1	5	5 U		10 U		5 U	
FT000251TU1	5	5 U		10 U		5 U	
FT000361TU1	14	5 U		10 U		5 U	
FT000371TU1	14	28		24		5	
FT000421TU1	18	5 U		10 U		5 U	
FT000431TU1	16	5 U		40		5 U	
FT000451TU1	17	5 U		10 U		5 U	
FT000461TU1	4	5 U		10 U		21	
FT000471TU1	5	5 U		10 U		5	
FT000481TU1	7	5 U		5 U		9	
FT000501TU1	9	5 U		5 U		10	
FT000511TU1	11	5 U		5 U		7	
FT000531TU1	18	20				5 U	
FT000541TU1	5	5 U		10 U		4	

COMPOUNDS NOT DETECTED IN ANY SAMPLES

CIS 1,3-DICHLOROPROPENE

TRANS-1,3-DICHLOROPROPENE

1,2-DICHLOROETHANE

VINYL ACETATE

CHLOROBENZENE

DIBROMOCHLOROMETHANE

1,2-DICHLOROETHENE

CARBON TETRACHLORIDE

2-HEXANONE

BENZENE

BROMOMETHANE

CHLOROMETHANE

CHLOROETHANE

VINYL CHLORIDE

CARBON DISULFIDE

BROMODICHLOROMETHANE

1,1-DICHLOROETHANE

1,1,2-TRICHLOROETHANE

1,1,2,2-TETRACHLOROETHANE

TABLE A 3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	STYRENE	Q	14 METHYL 2 PENTANONE	Q	METHYLENE CHLORIDE	Q
FT000651TU1	15	5 U		14		2	
FT000671TU1	14	28		10 U		5 U	
FT000681TU1	14	26		10 U		5 U	
FT000691TU1	14	5 U		10 U		5 U	
FT000771TU1	16	5 U		10 U		2	
FT000781TU1	5	5 U		5 U		2	
FT000811TU1	4	5 U		10 U		2	
FT000821TU1	5	5 U		10 U		2	
FT000831TU1	7	5 U		10 U		5 U	
FT000841TU1	8	5 U		10 U		1	
FT000851TU1	11	5 U				2	
FT000861TU1	12	5 U		10 U		2	
FT000871TU1	13	5 U		2		2	
FT000891TU1	15	5 U		20		5 U	
FT000941TU1-4	4	5 U		10 U		3 BJ	
FT000941TU1 5	5	5 U		10 U		3 BJ	
FT000941TU1 7	7	5 U		10 U		3 BJ	
FT000941TU1 9	9	5 U		10 U		2 BJ	
FT000941TU1 11	11	5 U		10 U		2 BJ	
FT000941TU1 18	18	5 U		10 U		5 U	
FT000951TU1-4	4	5 U		10 U		5 U	
FT000951TU1 5	5	5 U		10 U		2 BJ	
FT000951TU1 7	7	5 U		31		5 U	
FT000951TU1-9	9	5 U		37		2 BJ	
FT000951TU1 11	11	5 U		10		3 BJ	
FT000951TU1 18	18	5 U		5 J		3 BJ	
FT000961TU1 4	4	5 U		10 U		2 BJ	
FT000961TU1 5	5	5 U		10 U		3 BJ	
FT000961TU1 7	7	5 U		89		2 BJ	
FT000961TU1-9	9	5 U		69		3 BJ	
FT000961TU1 11	11	5 U		110		2 BJ	

TABLE A-3
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Concluded)

SAMPLE #	SAMPLE PT	STYRENE	Q	4 METHYL 2 PENTANONE	Q	METHYLENE CHLORIDE	Q
FT000981TU1 18	18	5 U		6 J		5 U	
FT000971TU1 4	4	5 U		10 U		2 BJ	
FT000971TU1 5	5	5 U		10 U		2 BJ	
FT000971TU1 7	7	5 U		9 BJ		2 BJ	
FT000971TU1 9	9	5 U		27 B		2 BJ	
FT000971TU1 11	11	5 U		22 B		2 BJ	
FT000971TU1 18	18	5 U		6 BJ		2 BJ	
FT000981TU1 1	1	5 U		10 U		2 BJ	
FT000981TU1 2	2	5 U		10 U		2 BJ	
FT001031TU1	17	5 U		14		5 U	
FT001041TU1	81D	5 U		10 U		5 U	

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION

SAMPLE #	SAMPLE PT	MONT	DAY	YEAR	ALUMINUM	Q	DISSOLVED	Q	ANTIMONY	Q	DISSOLVED	Q	BARIUM	Q	DISSOLVED	Q	BERYLLIUM	Q
					mg/L		ALUMINUM		mg/L		ANTIMONY		mg/L		BARIUM		mg/L	
FT00001ITU1	4	3	31	92	0.0825	B			0.0233	B			0.101	B			0.001	U
FT00004ITU1	4	4	1	92	0.44				0.0198	U			0.086				0.0006	U
FT00005ITU1	5	4	1	92	0.58				0.0198	U			0.14				0.0006	U
FT00006ITU1	1	4	2	92	0.029	U			0.0198	U			0.083				0.0006	U
FT00007ITU1	4	4	2	92	0.036				0.0198	U			0.049				0.0006	U
FT00014ITU1	3	4	7	92	0.17				0.0198	U			0.33				0.0006	U
FT00015ITU1	14	5	1	92	0.22				0.042	U			0.242				0.001	U
FT00016ITU1	16	4	24	92	0.11				0.0198	U			0.038				0.0006	U
FT00018ITU1	14	4	30	92	0.532	E			0.018	U			0.977	E			0.001	U
FT00042ITU1	16	6	4	92	0.029	U			0.0198	U			0.088				0.0006	U
FT00043ITU1	16	6	5	92	0.0425	B			0.0319	B			0.001	U			0.001	U
FT00045ITU1	17	6	8	92	0.034				0.0198	U			0.071				0.0006	U
FT00046ITU1	4	6	9	92	0.029	U	0.029	U	0.0198	U	0.0198	U	0.17		0.16		0.0006	U
FT00047ITU1	5	6	9	92	0.029	U	0.029	U	0.0198	U	0.022	U	0.17		0.17		0.0006	U
FT00048ITU1	7	6	9	92	0.029	U	0.029	U	0.0198	U	0.0198	U	0.16		0.16		0.0006	U
FT00049ITU1	8	6	9	92	0.029	U	0.034	U	0.0198	U	0.0198	U	0.16		0.11		0.0006	U
FT00050ITU1	9	6	9	92	0.029	U	0.029	U	0.0198	U	0.0198	U	0.029		0.024		0.0006	U
FT00051ITU1	11	6	9	92	0.029	U	0.029	U	0.0198	U	0.0198	U	0.026		0.024		0.0006	U
FT00052ITU1	12	6	9	92	0.029	U	0.068		0.0198	U	0.0198	U	0.0038	U	0.0038	U	0.0006	U
FT00053ITU1	18	6	9	92	0.029	U	0.029	U	0.0198	U	0.0198	U	0.0038	U	0.0038	U	0.0006	U
FT00055ITU1	15	6	12	92	0.064				0.0198	U			0.03				0.0011	
FT00057ITU1	14	6	15	92	0.33				0.032	B			2.42				0.0013	B
FT00058ITU1	14	6	15	92	0.415					B			2.37				0.002	B
FT00070ITU1	14	6	15	92	0.0256	B			0.016	U			0.0028	B			0.001	U
FT00088ITU1	15	7	24	92	0.047	B			0.026	B			0.065	B			0.003	U

TABLE A-4
SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	DISSOLVED BERYLLIUM mg/L	CADMIUM	Q	DISSOLVED CADMIUM mg/L	CALCIUM	Q	DISSOLVED CALCIUM mg/L	CHROMIUM	Q	DISSOLVED CHROMIUM mg/L	COBALT	Q	DISSOLVED COBALT mg/L
FT00001ITU1	4		0.002	U		56.8			0.0183			0.006	U	
FT00004ITU1	4		0.0023	U		74.7			0.002	U		0.0027	U	
FT00006ITU1	5		0.0023	U		74.5			0.002	U		0.0027	U	
FT00008ITU1	1		0.0023	U		80.3			0.002	U		0.0027	U	
FT00007ITU1	4		0.0023	U		85.3			0.002	U		0.0027	U	
FT00014ITU1	3		0.0023	U		247			0.068			0.0027	U	
FT00015ITU1	14		0.003	U		175			0.029			0.005	U	
FT00016ITU1	16		0.0023	U		1.8			0.002	U		0.0027	U	
FT00018ITU1	14		0.0033	B		702			0.037			0.004	U	
FT00042ITU1	16		0.0023	U		2.2			0.002	U		0.0027	U	
FT00043ITU1	16		0.004	U		0.751	U		0.007	U		0.007	U	
FT00045ITU1	17		0.0024	U		0.6			0.0049			0.0027	U	
FT00046ITU1	4	0.0006	0.0023	U	0.0023	83.6		81.7	0.0037		0.002	0.0027	U	0.0027
FT00047ITU1	5	0.0006	0.0023	U	0.0023	81.1		82.1	0.002	U	0.002	0.0027	U	0.0027
FT00048ITU1	7	0.0006	0.0023	U	0.0023	74.9		74.8	0.002	U	0.0038	0.0027	U	0.0027
FT00049ITU1	8	0.0006	0.0023	U	0.0023	73.1		51.6	0.002	U	0.0027	0.0027	U	0.0027
FT00050ITU1	9	0.0006	0.0023	U	0.0023	33.9		32.4	0.002	U	0.002	0.0027	U	0.0027
FT00051ITU1	11	0.0006	0.0023	U	0.0023	34.1		33.9	0.002	U	0.002	0.0027	U	0.0027
FT00052ITU1	12	0.0006	0.0023	U	0.0023	0.07		0.1	0.002	U	0.002	0.0027	U	0.0027
FT00053ITU1	18	0.0006	0.0023	U	0.0023	0.12		0.11	0.0025		0.0021	0.0027	U	0.0027
FT00055ITU1	15		0.0023	U		0.87			0.002	U		0.0027	U	
FT00067ITU1	14		0.002	U		933			0.021			0.007	B	
FT00068ITU1	14		0.002	U		915			0.0258			0.007	B	
FT00070ITU1	14		0.002	U		1.06	U		0.007	U		0.006	U	
FT00089ITU1	15		0.0022	B		1.37	B		0.004	U		0.0036	B	

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	COPPER mg/L	Q	DISSOLVED COPPER mg/L	IRON mg/L	Q	DISSOLVED IRON mg/L	MAGNESIUM mg/L	Q	DISSOLVED MAGNESIUM mg/L	MANGANES mg/L	Q	DISSOLVED MANGANESE mg/L
FT000011TU1	4	0.0142	B		0.0476	B		12.6			0.0031	B	
FT000041TU1	4	0.009			0.68			16.6			0.013		
FT000051TU1	5	0.009			0.77			16.6			0.013		
FT000081TU1	1	0.0023	U		0.022			19.6			0.0015	U	
FT000071TU1	4	0.0023	U		0.13			18.3			0.0015	U	
FT000141TU1	3	0.016			0.046			0.089			0.0015	U	
FT000151TU1	14	0.112			3.29			56.2			0.095		
FT000181TU1	16	0.0041			0.28			0.4			0.0049		
FT000181TU1	14	0.151			5.13	E		206	E		0.151		
FT000421TU1	16	0.0023			0.28			0.64			0.0034		
FT000431TU1	16	0.0066	B		0.029	U		0.054	U		0.0063	B	
FT000451TU1	17	0.0036			0.12			0.24			0.0022		
FT000461TU1	4	0.0056		0.0031	0.033		0.018	20.1	U	19.5	0.0015	U	0.0015
FT000471TU1	6	0.004		0.0046	0.38		0.044	19.4		19.7	0.0015	U	0.0015
FT000481TU1	7	0.004		0.0048	0.099		0.037	18		18	0.0015		0.0019
FT000491TU1	8	0.0023	U	0.0027	0.018	U	0.025	17.4		12.3	0.0015	U	0.0032
FT000501TU1	9	0.0023	U	0.0023	0.033		0.038	15.5		15.3	0.0015	U	0.0015
FT000511TU1	11	0.0023	U	0.0023	0.04		0.025	15.5		15.4	0.0015	U	0.0019
FT000521TU1	12	0.0023	U	0.0023	0.021		0.076	0.093	U	0.093	0.0015	U	0.0015
FT000531TU1	18	0.0023	U	0.0023	0.095		0.5	0.084		0.057	0.0015		0.0015
FT000551TU1	15	0.0034			0.096			0.32			0.0021		
FT000671TU1	14	0.118			1.92			197			0.27		
FT000681TU1	14	0.133			2.48			161			0.268		
FT000701TU1	14	0.004	U		0.0619	B		0.274	B		0.0041	B	
FT000891TU1	15	0.0069	B		0.248	E		0.438	B		0.0027	B	

Final

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	NICKEL mg/L	Q	DISSOLVED NICKEL mg/L	POTASSIUM mg/L	Q	DISSOLVED POTASSIUM mg/L	SODIUM mg/L	Q	DISSOLVED SODIUM	Q	THALLIUM mg/L	Q	DISSOLVED THALLIUM mg/L	VANADIUM mg/L
FT00001TU1	4	0.013	U		2.74	B		36.1				0.001	U		0.008
FT00004TU1	4	0.011	U		3.6			44.2				0.0017	U		0.0035
FT00005TU1	5	0.011	U		3.1			44.6				0.0017	U		0.0051
FT00006TU1	1	0.011	U		3.1			44.8				0.0017	U		0.0035
FT00007TU1	4	0.011	U		3.5			47.3				0.0017	U		0.0035
FT00014TU1	3	0.011	U		30.8			134				0.0017	U		0.027
FT00016TU1	14	0.091			22.2			8650				0.01	U		0.004
FT00018TU1	16	0.011	U		1.2			176				0.0016	U		0.0035
FT00018TU1	14	0.098			36.7			7400				0.002	UWN		0.049
FT00042TU1	16	0.011	U		1.4			215				0.0016	U		0.0035
FT00043TU1	16	0.019	U		1.38	U		2.68	B			0.001	U		0.011
FT00046TU1	17	0.011	U		0.674	U		18.7				0.002	U		0.0035
FT00048TU1	4	0.011	U		1.5			50		48.8		0.002	U	0.002	U
FT00047TU1	5	0.011	U		4.5			48.4		49.3		0.002	U	0.002	U
FT00048TU1	7	0.011	U		7.1			64.6		65		0.002	U	0.002	U
FT00049TU1	8	0.011	U		3.3			62.3		48.7		0.002	U	0.002	U
FT00050TU1	9	0.011	U		3.6			66.2		64.4		0.002	U	0.002	U
FT00051TU1	11	0.011	U		6.6			66		65.6		0.002	U	0.002	U
FT00052TU1	12	0.011	U		3.4			13.7		13.7		0.01	U	0.01	U
FT00053TU1	16	0.011	U		4			16.4		15.1		0.002	U	0.002	U
FT00056TU1	15	0.011	U		0.67	U		13.5				0.002	U		0.0035
FT00057TU1	14	0.127			46.4			8480				0.002	U		0.0006
FT00058TU1	14	0.14			44.9			8830				0.002	U		0.0082
FT00070TU1	14	0.013	U		0.838	U		13.2				0.001	U		0.008
FT00088TU1	15	0.004	U		0.35	B		9.45				0.001	U		0.0039

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	Q	DISSOLVED	Q	ZINC	mg/L	Q	DISSOLVED	Q	MOLYBDENU	Q	DISSOLVED	Q	TIN	mg/L	Q	DISSOLVED	Q	LITHIUM	Q
			VANADIUM					ZINC				MOLYBDEN					TIN		mg/L	
FT00001TU1	4	U			0.0284					0.011	U									
FT00004TU1	4	U			0.042					0.0047				0.0094					0.012	
FT00005TU1	5				0.04					0.0044				0.012					0.012	
FT00006TU1	1	U			0.048					0.0035	U			0.013					0.011	
FT00007TU1	4	U			0.03					0.0035	U			0.0094					0.011	
FT00014TU1	3				0.04					0.08				0.0094					0.03	
FT00015TU1	14	U			0.504					0.007	U			0.138					0.054	B
FT00016TU1	16	U			0.038					0.0035	U			0.0094					0.0072	
FT00018TU1	14	B			1.41					0.028	B			0.023					0.107	
FT00042TU1	16	U			0.023					0.0035	U			0.0094					0.0042	
FT00043TU1	16	U			0.0478					0.012	U									
FT00045TU1	17	U			0.014					0.0035	U			0.016					0.0822	
FT00046TU1	4		0.0035	U	0.038			0.0038		0.0035	U		0.0035	U	0.01		0.0094	U	0.013	
FT00047TU1	5		0.0035	U	0.034			0.0027		0.0035	U		0.0035	U	0.0094		0.0094	U	0.012	
FT00048TU1	7	U	0.0042		0.043			0.0087		0.0035	U		0.0038		0.0094		0.0094	U	0.01	
FT00049TU1	8	U	0.0035	U	0.018			0.082		0.0035	U		0.0035	U	0.0094		0.0094	U	0.0098	
FT00050TU1	9	U	0.0035	U	0.041			0.056		0.0035	U		0.0035	U	0.0094		0.0094	U	0.01	
FT00051TU1	11	U	0.0035	U	0.053			0.055		0.0035	U		0.0035	U	0.0094		0.0094	U	0.011	
FT00052TU1	12	U	0.0035	U	0.048			0.076		0.0035	U		0.0035	U	0.0094		0.0094	U	0.002	U
FT00053TU1	18	U	0.0035	U	0.058			0.048		0.0035	U		0.0035	U	0.0094		0.0094	U	0.002	U
FT00055TU1	15	U			0.014					0.0035	U								0.002	U
FT00057TU1	14	U			2.9					0.011	U									
FT00058TU1	14				3.01					0.011	U									
FT00070TU1	14	U			0.0123	B				0.011	U									
FT00089TU1	15	B			0.012	B				0.0089	B				0.032	U			0.0019	B

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	DISSOLVED LITHIUM	SILICON mg/L	Q	DISSOLVED SILICON	Q	LEAD mg/L	Q	DISSOLVED LEAD	Q	MERCURY mg/L	Q	DISSOLVED MERCURY	Q	SELENIUM mg/L	Q	DISSOLVED SELENIUM
FT000011TU1	4						0.0078				0.0002	U			0.0042	B	
FT000041TU1	4		5.5				0.0007	U			0.0002	U			0.0022		
FT000051TU1	5		5.8				0.0007	U			0.0002	U			0.004	U	
FT000081TU1	1		5.7				0.0008	U			0.0002	U			0.006		
FT000071TU1	4		5.8				0.0008	U			0.0002	U			0.0055		
FT000141TU1	3		2.4				0.0082				0.0002	U			0.22		
FT000151TU1	14		4.39				0.019				0.0001	B			0.002	U	
FT000181TU1	16		5.7				0.0013				0.0002	U			0.0009		
FT000181TU1	14		4.25				0.0091	SN			0.00021				0.037	BS	
FT000421TU1	16		5.1				0.0022				0.0002	U			0.0008	U	
FT000431TU1	16						0.0019	B			0.0002	U			0.001	U	
FT000451TU1	17		5.3				0.0008	U			0.0002	U			0.0008	U	
FT000461TU1	4	0.011	6.5		6.6		0.0008	U	0.0008	U	0.0002	U	0.0002	U	0.016		0.012
FT000471TU1	5	0.011	6.6		7.3		0.0008	U	0.0008	U	0.0002	U	0.0002	U	0.015		0.014
FT000481TU1	7	0.013	7		7.1		0.0008	U	0.0008	U	0.0002	U	0.0002	U	0.014		0.013
FT000481TU1	8	0.0084	6.7		7.7		0.0008	U	0.0011		0.0002	U	0.0002	U	0.0016		0.0008
FT000501TU1	9	0.0085	7		6.7		0.0014		0.0008	U	0.0002	U	0.0002	U	0.0018		0.0008
FT000511TU1	11	0.011	6.9		7		0.0014		0.038		0.0002	U	0.0002	U	0.0009		0.0008
FT000521TU1	12	0.002	6.9		6.4		0.0008	U	0.036		0.0002	U	0.0002	U	0.0008	U	0.0019
FT000531TU1	18	0.002	6.5		6		0.0024		0.12		0.0002	U	0.0002	U	0.0008	U	0.0019
FT000651TU1	15		5.2				0.0017				0.0002	U	0.0002	U	0.0008	U	0.0008
FT000671TU1	14						0.0086				0.00034				0.0008	U	
FT000681TU1	14						0.0136				0.00031				0.0058	B	
FT000701TU1	14						0.0013	B			0.0002	U			0.001	U	
FT000891TU1	15		4.53				0.001	U			0.0002	U			0.001	U	

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	Q	STRONTIUM	Q	DISSOLVED	Q	CESIUM	Q	DISSOLVED	Q	ARSENIC	Q	DISSOLVED	Q	SILVER	Q	DISSOLVED	Q
			mg/L		STRONTIUM		mg/L		CESIUM		mg/L		ARSENIC		mg/L		SILVER	
FT000011TU1	4		0.401															
FT000041TU1	4		0.53				0.5 U				0.0025 B				0.004 U			
FT000051TU1	5		0.53				0.5 U				0.0008 U				0.0021 U			
FT000061TU1	1		0.62				0.5 U				0.001				0.0021 U			
FT000071TU1	4		0.58				0.5 U				0.0008 U				0.0021 U			
FT000141TU1	3		2.7				0.5 U				0.0019 U				0.0021 U			
FT000161TU1	14		1.05				0.01 U				0.0008 U				0.0021 U			
FT000181TU1	16		0.012				0.5 U				0.0025 B				0.005 U			
FT000181TU1	14		4.28 E				0.07 BN				0.0007 U				0.0021 U			
FT000421TU1	16		0.0075				0.5 U				0.001 U				0.002 U			
FT000431TU1	16		0.001 U								0.0007 U				0.0021 U			
FT000461TU1	17		0.0033 U				0.5 U				0.0007 U				0.0021 U			
FT000481TU1	4		0.63				0.61				0.0028 U				0.0021 U			
FT000471TU1	5		0.61				0.62				0.0029 U				0.0023 U			
FT000481TU1	7		0.57				0.57				0.0029 U				0.0021 U			
FT000491TU1	8 U		0.55				0.39				0.0007 U				0.0021 U			
FT000501TU1	9 U		0.25				0.23				0.0009 U				0.0021 U			
FT000511TU1	11 U		0.25				0.25				0.0007 U				0.0021 U			
FT000521TU1	12		0.0033 U				0.0033 U				0.0007 U				0.0021 U			
FT000531TU1	18 U		0.0033 U				0.0033 U				0.0007 U				0.0021 U			
FT000661TU1	15		0.0033 U				0.5 U				0.0007 U				0.0021 U			
FT000671TU1	14		6.97				0.5 U				0.0008 U				0.0021 U			
FT000681TU1	14		6.79 B								0.0061 B				0.004 U			
FT000701TU1	14		0.006 B								0.0094 B				0.004 U			
FT000891TU1	15		0.0099 B				0.05 B				0.001 U				0.004 U			
											0.001 U				0.003 U			

TABLE A-4

SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Continued)

SAMPLE #	SAMPLE PT	BICARBONATE	CARBONAT	ALKALINITY	CHLORIDE	FLUORIDE	AMMONIA	NITRATE/NITRITE	SULFATE	Q
		mg/L	mg/L	AS CACO ₃	mg/L	mg/L	NH ₃	mg/L	mg/L	
FT000011TU1	4			152	51.7	0.57	0.03	2.81	48.5	
FT000041TU1	4	197	10 U		75	0.84		2460	51.2	
FT000051TU1	5	191	10 U		74.5	0.91		2580	50.9	
FT000081TU1	1	216	10.2		83	0.94		2190	44.8	
FT000071TU1	4	221	10 U		80	0.9		2630	52.9	
FT000141TU1	3	510	53.4		158	0.75		2.4	127	
FT000151TU1	14	39	10 U		13500	0.1 U		0.455	6.83	
FT000161TU1	16	10 U	10 U		450	0.82		0.21	5	U
FT000181TU1	14	10 U	10 U		12700	0.1 U		29.9	1150	
FT000421TU1	16	10 U	10 U		454	0.79		0.25	5	U
FT000431TU1	16			10 U	0.93	0.47		0.48	0.06	U
FT000451TU1	17	10 U	10 U		5	0.1 U		0.38	5	U
FT000461TU1	4	215	10 U		100	0.89		7.8	50.5	
FT000471TU1	5	213	10 U		77.7	0.86		7.8	52.7	
FT000481TU1	7	184	10 U		142	0.86		7.7	48.5	
FT000491TU1	8	98.5	10 U		188	0.86		2.5	5	U
FT000501TU1	9	10 U	10 U		199	0.82		2	5	U
FT000511TU1	11	10 U	10 U		257	0.86		1.9	5	U
FT000521TU1	12	10 U	10 U		248	0.82		1.6	5	U
FT000531TU1	18	10 U	10 U		19.2	0.67		55.1	5	U
FT000651TU1	15	10 U	10 U		23.6	0.53		0.27	5	U
FT000671TU1	14			10 U	0.04 U	36.5		1.75	33.9	
FT000681TU1	14			10 U	0.04 U	36.8		24.38	33.9	
FT000701TU1	14									
FT000891TU1	15	18	1 U		12	0.3		0.1	2	

TABLE A-4
SUMMARY OF METAL AND INORGANIC CONTAMINANTS DETECTED IN WATER SAMPLES
DURING TREATMENT SYSTEM OPERATION
(Concluded)

SAMPLE #	SAMPLE PT	TOTAL DISS Q mg/L	TOTAL SUS Q mg/L
FT00001TU1	4	337	4 U
FT00004TU1	4	374	13
FT00005TU1	5	396	15
FT00008TU1	1	448	5 U
FT00007TU1	4	434	5 U
FT00014TU1	3	12	5 U
FT00016TU1	14	22800	17
FT00018TU1	16	488	5 U
FT00018TU1	14	22800	129
FT00042TU1	16	642	5 U
FT00043TU1	16	31	4 U
FT00045TU1	17	52	7
FT00048TU1	4	470	5 U
FT00047TU1	5	468	5 U
FT00048TU1	7	484	55
FT00049TU1	8	692	5 U
FT00050TU1	9	512	5 U
FT00051TU1	11	530	5 U
FT00052TU1	12	62	5 U
FT00053TU1	18	70	5 U
FT00065TU1	15	74	5
FT00067TU1	14	9483	13
FT00068TU1	14	9305	8
FT00070TU1	14		
FT00089TU1	15	30	4 U

Final

TABLE A 5
SUMMARY OF RADIONUCLIDES DETECTED IN WATER SAMPLES DURING
TREATMENT SYSTEM OPERATION

SAMPLE #	SAMPLE PT	MONT	DAY	YEAR	SR-90	Q	AM 241	Q	AM 243	Q	PU 236	Q	PU 238	Q	PU 239	Q	PU 242	Q
					pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L	
FT00006ITU1	1	4	2	92	1 779													
FT00007ITU1	4	4	2	92	3 266		0 001 J						0 001 J		0 005 J			
FT00014ITU1	3	4	7	92	2 41		0 007 J								0 013 J			
FT00015ITU1	14	5	1	92	80 018		0 002				0 005				0 001			
FT00016ITU1	16	4	24	92	7 48						0 005				0 003			
FT00018ITU1	14	4	30	92	39 16										0 032			
FT00038ITU1	17	5	29	92	9 41		-0 00442		0		0 002		0 000863		0 801		0	
FT00042ITU1	16	6	4	92	19 73		-0 00929		0		0 007		0 006		1 036		0	
FT00048ITU1	7	6	9	92			-0 00567				0		0 028		0 008		0	
FT00049ITU1	8	6	9	92			-0 00928		0		0 008		0 032		-0 00931		0	
FT00083ITU1	7	7	22	92	0 07		-0 00765		0		0 002		0 000783		0 0062		0	
FT00084ITU1	8	7	22	92	0 2		-0 00718		0		0 004		0 005		0 001		0	
FT00089ITU1	15	7	24	92	0		-0 00928		0		0 003		-0 00108		-0 000796		0	

Final

ERM

TABLE A-5

SUMMARY OF RADIONUCLIDES DETECTED IN WATER SAMPLES DURING
TREATMENT SYSTEM OPERATION
(Concluded)

SAMPLE #	SAMPLE PT	GBETA	Q	GALPHA	Q	H-3	Q	U 232	Q	U 234	Q	U 235	Q	U 238	Q	CS-134	Q	CS-137
		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L		pCi/L
FT000061TU1	1	6 38		0 86		99 099				2 436		0 119	J	1 472		1 16	U	1 11
FT000071TU1	4	3 91		0 93		157 658				1 112		0 4		0 699		1 41	U	1 4
FT000141TU1	3	23 09		1043		181 53				0 016	J	0 004	J	0		10 4	U	10 3
FT000151TU1	14	-0 45045		2 072072		0				0 081		0 004135		0 054054		2 28	U	2 09
FT000161TU1	16	-3 78378	J	0 36036		3 97				0 027027		0 010189		0 021837		2 23	U	2 16
FT000181TU1	14	2 7027		1 8018		1 93				0 033		0 038		0 018				
FT000381TU1	17			0		74 78		0		0 118		0 055		0 045				
FT000421TU1	16			0		279 28		0		0 359		0 178		0 115				
FT000481TU1	7	40 4		2 07				0		3 849		0 477		2 741				
FT000491TU1	8	29 73		3 16				0		0		0 006		0 004				
FT000831TU1	7	37 06		1 95		219 82		0		3 992		0 209		2 89				
FT000841TU1	8	24 62		0 2		181 71		0		0 035		0 015		0 015				
FT000891TU1	15	25 12		0 12		111 71		0		0		0		0				

EG&G ROCKY FLATS PLANT
Systems Operation and Optimization
Report for Operable Unit 1

Manual

21000-RP-OU01 5

Section

Appendix B

Revision

0

Page

1 of 1

Effective Date

Organization

ERM

Final

TITLE Material Safety Data Sheets

Approved By

McBumarta 11 / 20 / 92

Name

(Date)

Appendix B MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets are presented in the following pages



201 } COATING
202 }
203 }
204 }

SERIES 20 POTA POX

EPOXY-POLYAMIDE POTABLE WATER TANK SYSTEM

Series P20 conforms with all air pollution regulations limiting Volatile Organic Compounds (VOC) to a maximum of 340 grams/liter (2.8 lbs./gal)



COATING PROFILE

DESCRIPTION	Corrosion-resistant coating system for steel and concrete potable water storage facilities. High-build properties provide outstanding protection with fewer coats, particularly on edges and in pits. Conforms to NSF Std 61, AWWA D 102, Inside System No 1 and AWWA C 210. Contact your Tnemec representative for approved systems in potable water service.																																
TYPICAL USE	Coating the interior and/or exterior of steel tanks and concrete reservoirs used for potable water service. Also recommended for valves, pumps, pipes and other related potable water contact equipment.																																
PRIMERS	Self-Priming																																
TOPCOATS	INTERIOR: 20-1255 Beige, 20-AA83 Tank White, 20-AA90 White, P20-1255 Beige, P20-AA83 Tank White and P20-AA90 White. EXTERIOR: Series 20 & P20 Pota-Pox, Series 70 & 71 Endura-Shield, Series 73 Endura-Shield, Series 74 & 75 Endura-Shield or Series 161 Tnemec-Fascure. Refer to applicable topcoat data sheet for color availability and additional information. Series 20 exterior exposed for 3 weeks or longer requires an epoxy intermediate coat or scarification prior to topcoating with Series 70 & 71 Endura-Shield. Refer to Series 70 & 71 product data sheet for additional information.																																
SURFACE PREPARATION	STEEL: Immersion Service—Near White Blast Cleaning (SSPC-SP10). Non-Immersion Service—Commercial Blast Cleaning (SSPC-SP6). PRIMED SURFACES: Immersion Service—Scarify the Series 20 prime coat surface by brush-blasting before topcoating if the prime coat has been exposed to sunlight 60 days or longer and Series 20 is the specified topcoat. CONCRETE: Allow new concrete to cure for 28 days. Brush-off blast. Holes, pits, voids and cracks in brush-blasted concrete should be filled with 63-1500 Filler and Surfacer (ANSI/NSF Std 61 certified). ALL SURFACES must be dry and clean.																																
COLORS	20-1211 Red, 20-1255 Beige, 20-AA83 Tank White, 20-AA90 White, P20-1211 Red, P20-1255 Beige, P20-AA83 Tank White, P20-AA90 White. Epoxies chalk with extended exposure to sunlight. Lack of ventilation and/or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of cure may cause yellowing to occur.																																
SOLIDS BY VOLUME	58.0 = 2.0 (Mixed)																																
VOLATILE ORGANIC COMPOUNDS (VOC)	<table> <tr> <th rowspan="2"></th><th colspan="2">UNTHINNED</th><th colspan="2">THINNED 10 % (No. 4 Thinner)</th><th colspan="2">THINNED 10 % (No. 7 Thinner)</th></tr> <tr> <th>Grams/Liter</th><th>Lbs./Gal</th><th>Grams/Liter</th><th>Lbs./Gal</th><th>Grams/Liter</th><th>Lbs./Gal</th></tr> <tr> <td>Series 20</td><td>362-369</td><td>3.02-3.08</td><td>404-410</td><td>3.37-3.42</td><td></td><td></td></tr> <tr> <td>Series P20</td><td>298-315</td><td>2.49-2.63</td><td></td><td></td><td>322-336</td><td>2.68-2.80</td></tr> </table>							UNTHINNED		THINNED 10 % (No. 4 Thinner)		THINNED 10 % (No. 7 Thinner)		Grams/Liter	Lbs./Gal	Grams/Liter	Lbs./Gal	Grams/Liter	Lbs./Gal	Series 20	362-369	3.02-3.08	404-410	3.37-3.42			Series P20	298-315	2.49-2.63			322-336	2.68-2.80
	UNTHINNED		THINNED 10 % (No. 4 Thinner)		THINNED 10 % (No. 7 Thinner)																												
	Grams/Liter	Lbs./Gal	Grams/Liter	Lbs./Gal	Grams/Liter	Lbs./Gal																											
Series 20	362-369	3.02-3.08	404-410	3.37-3.42																													
Series P20	298-315	2.49-2.63			322-336	2.68-2.80																											
THEORETICAL COVERAGE	595 mil sq ft per gallon																																
DRY FILM THICKNESS	Primer: 3.0 to 5.0 mils per coat Topcoat & Intermediate Coats: 4.0 to 6.0 mils per coat																																
CURING TIME—AT 75 F	To handle: 10 hours To recoat: 12 hours Immersion Service: 7 days																																
FORCE CURE	1st Coat: 24 hours at 75 F 2nd Coat: Flash 2 to 4 hours at 75 F followed with 24 hours at 150 F plus 24 hours at 75 F																																
TEMPERATURE RESISTANCE	(Dry) Continuous 250 F Intermittent 275 F																																
MIXING RATIO	By volume—One (Part A) to One (Part B)																																
SPECIAL QUALIFICATIONS	Series 20 & P20 have been certified by the National Sanitation Foundation in accordance with ANSI/NSF Std 61 for potable water contact. Ambient air cured Series 20 & P20 are qualified for use on the interior of potable water storage tanks and reservoirs of 1,000 gallon capacity or greater. Force-cured Series 20 is qualified for potable water tanks of 100 gallons or greater. Contact your Tnemec representative for approved ANSI/NSF Std 61 systems and additional information on potential uses.																																

Values may vary with color



SERIES 20 POTA-POX

PERFORMANCE CRITERIA

This product will meet or exceed the following test requirements established for the coating systems listed

ABRASION *Method* ASTM D 4060 CS-17 Wheel 1 000 grams load
System 20-2 One-Coat Pota-Pox (4.0 to 5.0 mils DFT), 30 days cure prior to testing
Requirement. No more than 115 mg loss after 1 000 cycles

ADHESION *Method* ASTM D 4541
System 20-1 Two-Coat Pota-Pox (4.0 to 5.0 mils DFT/coat). Coating system applied to SSPC-SP10 sandblasted steel and cured 14 days prior to testing.
Requirement: Not less than 1,000 psi pull average of three tests.

Method ASTM D 3359 Method B Crosshatch adhesion
System 20-1 Two-Coat Pota-Pox. Coating system applied to SSPC-SP10 sandblasted steel and cured 7 days prior to testing
Requirement: Not less than a rating of 5, (no removal), average of three tests

FRESH WATER *Method* Coating system applied to SSPC-SP10 cleaned hot-rolled steel cured 7 days prior to testing and immersed in aerated tap water at 77 F
System 20-1 Two-Coat Pota-Pox (4.0 to 5.0 mils DFT/coat)
Requirement No blistering delamination or other loss of film integrity after 4 years exposure.

SALT SPRAY (FOG) *Method* ASTM B 117 applied to SSPC-SP10 cleaned hot rolled steel
System 20-1 Two-Coat Pota-Pox (4.0 to 5.0 mils DFT/coat) cured 10 days prior to testing
Requirements No blistering rusting cracking or delamination of film No more than 1/16 in rust creepage at scribe after 1 000 hours exposure.

DIELECTRIC STRENGTH *Method* ANSI/ASTM D 149 (short term test)
System 20-1 Two-Coat Pota-Pox (5.0 to 6.0 mils DFT/coat) Coating system applied to SSPC-SP10 cleaned steel and cured 30 days prior to testing
Requirement: No less than 1 050 volts/mil average of five tests



SERIES 20 POTA POX

APPLICATION INFORMATION

MIXING Use power mixer to stir contents of each container making sure no pigment remains on the bottom. Pour a measured amount of Part B into a clean container large enough to hold both components. Add an equal volume of Part A to Part B while under agitation. Continue agitation until the two components are thoroughly mixed. Do not use mixed material beyond pot life limits. **NOTE:** For application between 50 F to 80 F, both components (Part A & B) should be above 50 F prior to mixing. Allow mixed material to stand thirty (30) minutes before application; restir before using.

SPREADING RATE

	Primer			Intermediate and/or Topcoat		
	Dry Mills	Wet Mills	Sq.Ft./Gal	Dry Mills	Wet Mills	Sq.Ft./Gal
Suggested	4.0	7.0	225	5.0	9.0	180
Minimum	3.0	5.5	299	4.0	7.0	225
Maximum	5.0	9.5	180	6.0	10.5	150

Allow for overspray and surface irregularities. Film thickness is based on closest 0.5 mil. Roller or brush application requires two coats to obtain recommended film thickness. Application of coating below minimum or above maximum dry mil thickness recommended may adversely affect coating performance.

THINNING

Series 20: Use No. 4 Thinner. For airless spray roller or brush thin up to 5% (about 1/4 pint per gallon) for air spray thin up to 10% (about 3/4 pint per gallon). **CAUTION:** Series 20 NSF certification is based on thinning with No. 4 Thinner. Thinning with any thinner other than No. 4 negates ANSI/NSF Std. 61 certification.

Series P20: Use No. 7 Thinner. For airless spray roller or brush thin up to 5% (about 1/4 pint per gallon) for air spray thin up to 10% (about 3/4 pint per gallon). **CAUTION:** Series P20 NSF certification is based on thinning with No. 7 Thinner. Thinning with any thinner other than No. 7 negates ANSI/NSF Std. 61 certification.

POT LIFE

20 hours at 50 F 10 hours at 77 F 4 hours at 100 F

SURFACE TEMPERATURE

Minimum 50 F Maximum 135 F

The surface should be dry and at least 5 F above the dew point. Coating will not cure below minimum surface temperature.

APPLICATION EQUIPMENT

Air spray airless spray brush or roller

Air Spray

Suggested equipment or equal

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss	E	765	5/16	3/8	75-100	10-20
MBC or JGA		or 76	or 3/8	or 1/2	psi	psi

Low temperatures or longer hoses require higher pot pressure

Airless Spray

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015 to 0.019	1800-3000 psi	1/4 or 3/8	60 mesh

Use appropriate tip and atomizing pressure for equipment, applicator technique and weather conditions.

Roller

Roller application optional when environmental restrictions do not allow spraying. Use 3/8" or 1/2" nap synthetic covers such as EZ Paintrol or equivalent. Two coats required to obtain recommended film thickness.

WARNING! Series P20 and No. 7 Thinner contain chlorinated solvent. Paints containing chlorinated solvent should not be used in pressurizable spray equipment having aluminum-wetted parts. Under certain unpredictable conditions, an explosive reaction can occur. This possible hazard affects any pressurizable fluid system or component, such as pumps, heaters, filters, surge tanks, regulators, valves, spray guns or pressure pots. Recommended materials of construction include black iron, steel or stainless steel. Specific questions should be addressed to your equipment supplier.

CLEANUP INSTRUCTIONS

Clean all equipment immediately after use with the recommended thinner or a compatible solvent such as Methyl Ethyl Ketone (MEK). Flush and clean spray equipment before material sets up.

Values may vary with color

SERIES 20 POTA POX

SHIPPING, STORAGE & SAFETY

NUMBER OF COMPONENTS	Two—Part A and Part B	
PACKAGED IN	5 gallon pails and 1 gallon cans—All sizes must be ordered in multiples of 2.	
NET WEIGHT PER GALLON	12.50 ± 0.25 lbs (Mixed)	
STORAGE TEMPERATURE	Minimum 20 F	Maximum 110 F
SHELF LIFE	12 months at recommended storage temperature	
FLASH POINT—SETA	Series 20: Part A 82 F —Part B 64 F Series P20: Part A 82 F —Part B 64 F	
SAFETY INFORMATION	This product (and any recommended thinners) contains solvents and/or other chemical ingredients. Adequate health and safety precautions should be observed during storage handling, application and curing. For information regarding the potential hazards associated with this product please refer to the container label or request a Material Safety Data Sheet from Tnemec Company Inc at the address noted in this data sheet. Please direct your inquiries to the attention of our Safety Director.	

Values may vary with color

WARRANTY & LIMITATION OF SELLER'S LIABILITY

Tnemec Company Inc warrants only that its coatings represented herein meet the formulation standards of Tnemec Company Inc

THE WARRANTY DESCRIBED IN THE ABOVE PARAGRAPH SHALL BE IN LIEU OF ANY OTHER WARRANTY EXPRESSED OR IMPLIED INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

The buyer's sole and exclusive remedy against Tnemec Company Inc shall be for replacement of the product in the event that a defective condition of the product should be found to exist. NO OTHER REMEDY (INCLUDING BUT NOT LIMITED TO INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY OR ANY OTHER INCIDENTAL OR CONSEQUEN-

TIAL LOSS) SHALL BE AVAILABLE TO THE BUYER. The sole purpose of this exclusive remedy shall be to provide buyer with replacement of the product if any defect in materials is found to exist. This exclusive remedy shall not be deemed to have failed its essential purpose so long as Tnemec Company Inc is willing and able to replace the defective materials.

Technical and application information herein is provided for the purpose of establishing a general profile of the coating and proper coating application procedures. Test performance results were obtained in a controlled environment and Tnemec Company makes no claim that these tests or any other tests accurately represent all environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection and use of the coating.

PUBLISHED TECHNICAL DATA AND INSTRUCTIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. CONTACT YOUR TNEMEC REPRESENTATIVE FOR CURRENT TECHNICAL DATA AND INSTRUCTIONS.

FOR INDUSTRIAL USE ONLY

TNEMEC COMPANY, INC.
Post Office Box 411479
K.C. Mo 64141-1749
(816) 483-3400
FAX: (816) 483 1251



Manufacturing Plants:
Kansas City Missouri
Baltimore Maryland
Compton California

IX-1 resin
28-cuft
#29,714

7

MATERIAL SAFETY DATA SHEET

SYBRON CHEMICALS INC
BIRMINGHAM ROAD
BIRMINGHAM, NJ 08011

EMERGENCY NO (609) 893 1100
PREPARED BY REGULATORY AFFAIRS
DATE OF LAST REVISION 03/13/90

PRODUCT

Product Identifier: IONAC A-440 IONAC A-641 IONAC A-641/HP IONAC A-642 IONAC A-642/HP
IONAC ASB-1 IONAC ASB-1/BZ, IONAC ASB-1/HP IONAC ASB-1C IONAC ASB-1P
IONAC ASB-1P/BZ, IONAC ASB-1P/HP IONAC ASB-1PC, IONAC 3AX3

Chemical Name Trimethylamine functionalized, chloromethylated copolymer of styrene and divinylbenzene in the chloride form

Common Name Ion Exchange Resin

Product Use Water Treatment Deionization

Ingredients

Compound	CAS REGISTRY NO	CONCENTRATION RANGE (%)
TRIMETHYLAMINE FUNCTIONALIZED CHLOROMETHYLATED COPOLYMER OF STYRENE AND DIVINYLBENZENE IN THE CHLORIDE FORM	69011 19 4	40 50
WATER	7732 18-5	50 60

PHYSICAL DATA

Physical State: Solid Boiling Point (°C) Not Applicable
Specific Gravity 1.2 Vapor Density (Air=1) 0.62 for water
Vapor Pressure (mm/Hg) 17 at 20°C for water
Solubility in Water Insoluble
Coefficient of water/oil distribution Not Applicable
Odor Threshold (ppm) Not Applicable

Freezing Point (°C) 0
pH (in an aqueous slurry) = 7-9
Evaporation Rate (H₂O=1) 1
Appearance Spherical Beads
Odor Slight Fish Odor

REACTIVITY DATA

NFPA Reactivity Rating: 0 stable

Conditions under which product is chemically unstable: At temperatures above 204°C decomposition occurs Explosive reactions can occur in the presence of strong oxidizing agents

Incompatible Materials Strong oxidizing agents such as nitric acid

Hazardous decomposition products Carbon monoxide carbon dioxide styrene divinylbenzene

Hazardous Polymerization Will not occur

FIRE HAZARD

NFPA Fire Hazard Class 1 Above 200°F (93°C)

Flashpoint (°C) Not Applicable

Auto Ignition Temperature (°C) Greater Than 500

Conditions of Flammability Not Applicable

Means of Extinction Dry chemical, Carbon dioxide or water fog

Upper flammable limit Not Applicable

Lower flammable limit Not Applicable

Hazardous combustion products Same as Reactivity Data Section

Explosion data

Sensitivity to mechanical impact Not Applicable Sensitivity to static discharge Not Applicable

Special Fire Fighting Procedures Wear MSHA/NIOSH approved pressure demand self-contained breathing apparatus Guard against contact of product with eye during salvage operation

IX 007

IX-2 resin
32 cu ft
\$ 7,968

1

MATERIAL SAFETY DATA SHEET

SYBRON CHEMICALS INC.
BIRMINGHAM ROAD
BIRMINGHAM, NJ 08011

EMERGENCY NO (609) 893 1100
PREPARED BY REGULATORY AFFAIRS
DATE OF LAST REVISION 03/13/90

PRODUCT

Product Identifier: IONAC CC, IONAC CC/HP IONAC CNN

Chemical Name: Hydrolyzed copolymer of polyacrylic and divinylbenzene in hydrogen form

Common Name: Ion Exchange Resin

Product Use: Water Treatment Deionization

Ingredients

Compound	CAS REGISTRY NO	CONCENTRATION RANGE (%)
HYDROLYZED COPOLYMER OF POLYACRYLIC AND DIVINYLBENZENE IN HYDROGEN FORM	69011-42-3	45 60
WATER	7732-18-5	40 55

PHYSICAL DATA

Physical State: Solid Boiling Point (°C) Not Applicable Freezing Point (°C) 0
Specific Gravity: 1.2 Vapor Density (Air=1) 0.62 for water pH (in an aqueous slurry) = 3-6
Vapor Pressure (mm/Hg) 17 at 20°C for water Evaporation Rate (H₂O=1) 1
Solubility in Water: Insoluble Appearance: Spherical Beads
Coefficient of water/oil distribution: Not Applicable Odor: Odorless
Odor Threshold (ppm) Not Applicable

REACTIVITY DATA

NFPA Reactivity Rating: 0 stable

Conditions under which product is chemically unstable: At temperatures above 204 C decomposition occurs. Explosive reactions can occur in the presences of strong oxidizing agents

Incompatible Materials: Strong oxidizing agents such as nitric acid.

Hazardous decomposition products: Carbon monoxide, carbon dioxide, divinylbenzene

Hazardous Polymerization: Will not occur

FIRE HAZARD

NFPA Fire Hazard Class: 1 Above 200°F (93 C)

Flashpoint (°C) Not Applicable

Auto Ignition Temperature (°C) Greater Than 500 Conditions of Flammability: Not Applicable

Means of Extinction: Dry chemical, Carbon dioxide or water fog.

Upper flammable limit: Not Applicable

Lower flammable limit: Not Applicable

Hazardous combustion products: Same as Reactivity Data Section

Explosion data:

Sensitivity to mechanical impact: Not Applicable Sensitivity to static discharge: Not Applicable

Special Fire Fighting Procedures: Wear MSHA/NIOSH approved pressure demand, self-contained breathing apparatus. Guard against contact of product with eye during salvage operation

IX-3 resin
56 cu ft
\$5,544

4

MATERIAL SAFETY DATA SHEET

SYBRON CHEMICALS INC
BIRMINGHAM ROAD
BIRMINGHAM NJ 08011

EMERGENCY NO (609) 893-1100
PREPARED BY REGULATORY AFFAIRS
DATE OF LAST REVISION 09/07/90

PRODUCT

Product Identifier IONAC C-240H IONAC C-242 IONAC C-244 IONAC C-251 IONAC C-267
IONAC C-267/SG IONAC C-295 IONAC C-298H, IONAC C-299/BZH, IONAC C-299H,
IONAC CFP 110/BZH IONAC CFP 110/HPH, IONAC CFP 110/SG IONAC CFP 110H,
IONAC NC-10 IONAC NC-11

Chemical Name. Benzene, diethenyl polymer with ethenylbenzene and ethenylethylbenzene, sulfonated in hydrogen form

Common Name. Ion Exchange Resin

Product Use: Water Treatment Deionization

Ingredients

Compound

CAS
REGISTRY NO

CONCENTRATION
RANGE (%)

BENZENE DIETHENYL POLYMER WITH ETHENYLBENZENE AND
ETHENYLETHYLBENZENE SULFONATED (HYDROGEN FORM)

69011 20-7

50 60

WATER

7732 18-5

40 50

PHYSICAL DATA

Physical State: Solid Boiling Point (°C) Not Applicable

Freezing Point (°C) 0

Specific Gravity 1.3 Vapor Density (Air=1) 0.62 for water

pH (in an aqueous slurry) = 6-9

Vapor Pressure (mm/Hg) 17 at 20°C for water

Evaporation Rate (H₂O=1) 1

Solubility in Water: Insoluble

Appearance: Spherical Beads

Coefficient of water/oil distribution: Not Applicable

Odor: Odorless

Odor Threshold (ppm) Not Applicable

REACTIVITY DATA

NFPA Reactivity Rating: 0 stable

Conditions under which product is chemically unstable: At temperatures above 204°C decomposition occurs. Explosive reactions can occur in the presence of strong oxidizing agents.

Incompatible Materials: Strong oxidizing agents such as nitric acid.

Hazardous decomposition products: Carbon monoxide, carbon dioxide, styrene, divinylbenzene.

Hazardous Polymerization: Will not occur

FIRE HAZARD

NFPA Fire Hazard Class: 1 Above 200°F (93°C)

Flashpoint (°C) Not Applicable

Auto Ignition Temperature (°C) Greater Than 500

Conditions of Flammability: Not Applicable

Means of Extinction: Dry chemical, Carbon dioxide or water fog.

Upper flammable limit: Not Applicable

Lower flammable limit: Not Applicable

Hazardous combustion products: Same as Reactivity Data Section

Explosion data:

Sensitivity to mechanical impact: Not Applicable Sensitivity to static discharge: Not Applicable

Special Fire Fighting Procedures: Wear MSHA/NIOSH approved pressure demand, self-contained breathing apparatus. Guard against contact of product with eye during salvage operation.

IX-004

IX-4 RESIN

56 cu ft

\$17,300

12

MATERIAL SAFETY DATA SHEET

SYBRON CHEMICALS INC
BIRMINGHAM ROAD
BIRMINGHAM, NJ 08011

EMERGENCY NO (609) 893 1100
PREPARED BY REGULATORY AFFAIRS
DATE OF LAST REVISION 03/13/90

PRODUCT

Product Identifier IONAC AFP 329

Chemical Name. Dimethylamine functionalized chloromethylated copolymer of styrene and divinylbenzene in the free base form

Common Name. Ion Exchange Resin

Product Use. Water Treatment Deionization

Ingredients

Compound	CAS REGISTRY NO	CONCENTRATION RANGE (%)
DIMETHYLAMINE FUNCTIONALIZED CHLOROMETHYLATED COPOLYMER OF STYRENE AND DIVINYLBENZENE IN THE FREE BASE FORM	69011 17 2	40 60
WATER	7732 18-5	40 60

PHYSICAL DATA

Physical State: Solid Boiling Point (°C) Not Applicable
Specific Gravity 1.1 Vapor Density (Air=1) 0.62 for water
Vapor Pressure (mm/Hg) 17 at 20°C for water
Solubility in Water Insoluble
Coefficient of water/oil distribution. Not Applicable
Odor Threshold (ppm) Not Applicable

Freezing Point (°C) 0
pH. (in an aqueous slurry) = 8-9
Evaporation Rate (H₂O=1) 1
Appearance. Spherical Beads
Odor Slight Odor of Fish

REACTIVITY DATA

NFPA Reactivity Rating: 0 stable

Conditions under which product is chemically unstable: At temperatures above 204 C decomposition occurs Explosive reactions can occur in the presences of strong oxidizing agents

Incompatible Materials Strong oxidizing agents such as nitric acid.

Hazardous decomposition products Carbon monoxide, carbon dioxide styrene divinylbenzene

Hazardous Polymerization. Will not occur

FIRE HAZARD

NFPA Fire Hazard Class 1 Above 200°F (93°C)

Flashpoint (°C) Not Applicable

Auto Ignition Temperature (°C) Greater Than 500

Conditions of Flammability Not Applicable

Means of Extinction. Dry chemical Carbon dioxide or water fog.

Upper flammable limit Not Applicable

Lower flammable limit Not Applicable

Hazardous combustion products Same as Reactivity Data Section

Explosion data.

Sensitivity to mechanical impact Not Applicable Sensitivity to static discharge Not Applicable

Special Fire Fighting Procedures Wear MSHA/NIOSH approved pressure demand self-contained breathing apparatus Guard against contact of product with eye during salvage operation

IX-012

K190110

possible fire and explosion risk. For closed containers, pressure build-up and possible explosion might occur due to extreme heat exposure. Solvent vapors are heavier than air and may travel considerable distance to a source of ignition and flash back.

SPECIAL FIRE FIGHTING PROCEDURES
Water may be used to cool unruptured containers. Wear self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode to prevent inhalation of hazardous decomposition products. Use appropriate extinguishing media to control fire. Water may cause violent frothing if sprayed directly into containers of burning liquid.

SECTION 05 - REACTIVITY DATA**STABILITY****INCOMPATIBILITY (MATERIALS TO AVOID)**

Strong oxidizing agents
Bases
Acids

CONDITIONS TO AVOID

Heat, sparks, open flames
Epoxy compounds under uncontrolled conditions.
Isocyanate compounds under uncontrolled conditions.

HAZARDOUS DECOMPOSITION PRODUCTS - FIRE, BURNING OR WELDING OF COATING PRODUCTS MAY FORM

Carbon monoxide, carbon dioxide, hydrocarbon fragments
Nitrogen monoxide, nitrogen dioxide
Trace amounts of HCN

HAZARDOUS POLYMERIZATION

Will not occur.

SECTION 06 - SPILL OR LEAK PROCEDURES**STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED**

Remove all sources of ignition. Spills may be collected with inert, absorbent material for proper disposal. Use non-sparking tools, protective gloves, goggles and clothing, adequate ventilation, avoid the breathing of vapors and use respiratory protective devices. Transfer absorbent material to suitable containers for proper disposal.

WASTE DISPOSAL METHOD

Dispose of in accordance with Federal, state, and local regulations regarding pollution.

SECTION 07 - SAFE HANDLING AND USE INFORMATION**RESPIRATORY PROTECTION**

Respiratory protective devices must be used when engineering and administrative controls are not adequate to maintain Threshold Limit Values (TLV) and Permissible Exposure Limits (PEL) of airborne contaminants below the listed values for those hazardous ingredients identified in Section II of this MSDS. Observe OSHA regulations for respirator use (CFR 29, 1910.134) whenever a respirator is used.

Particulate, chemical cartridge, air purifying half-mask respirators can be used within certain limitations, consult the respirator manufacturer for specific uses and limitations. Where airborne contaminant concentrations are unknown, the use of a NIOSH/MSHA approved fresh-air supplied respirator is mandatory.

VENTILATION

Sufficient ventilation, in volume and pattern, should be provided through both local and general exhaust to keep the air contaminant concentration below current applicable OSHA Permissible Exposure Limits (PEL) and ACGIH's Threshold Limit Values (TLV). Appropriate ventilation should be employed to remove hazardous decomposition products formed during welding or flame cutting operations of surfaces coated with this product.

Heavier than air solvent vapors should be removed from lower levels of work area due to potential explosion hazard and all ignition sources (non-explosion proof equipment) should be eliminated if flammable mixtures will be encountered.

PROTECTIVE GLOVES

Chemical resistant

EYE PROTECTION

Use chemical resistant splash type goggles

OTHER PROTECTIVE EQUIPMENT

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Use chemical resistant coveralls or apron to protect against skin and clothing contamination

HYGIENIC PRACTICES

Wash hands and other contaminated skin areas with warm soap and water before eating

SECTION 08 - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

Store in dry area. Keep closures tight and upright to prevent leakage. Do not store in high temperature areas or near fire or open flame. Refer to product data sheet for recommended storage temperatures

OTHER PRECAUTIONS

Do not use near heat, sparks, or open flame. Use approved grounding procedures. Prevent prolonged breathing of vapor or spray mist. Prevent contact with skin and eyes. Do not take internally. Keep out of reach of children. Do not reuse or alter containers without proper industrial cleaning. Do not weld or flame cut empty, uncleaned containers due to potential fire and explosion hazard. Consult product data sheet for proper application instructions.

SECTION 09 - PHYSICAL DATA

BOILING RANGE (F AT 760 MMHG) 241 - 288
VAPOR DENSITY HEAVIER THAN AIR
WEIGHT PER GALLON 14.41
% VOLATILE BY VOLUME 45.000
% SOLIDS BY WEIGHT 78.214
EVAPORATION RATE SLOWER - ETHYL ETHER
VOC (LBS/GAL) 3.127

SECTION 10 - OTHER INFORMATION

For specific information regarding occupational safety and health standards, please refer to the Code of Federal Regulations, Title 29, Part 1910.

To the best of our knowledge, the information contained herein is accurate. However, neither the Inemec Company or any of its subsidiaries assume any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown health hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

SECTION 11 - RIGHT-TO-KNOW INFORMATION

THIS PRODUCT CONTAINS THE FOLLOWING TOXIC CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF THE EMERGENCY PLANNING & COMMUNITY RIGHT TO-KNOW ACT OF 1986 AND OF 40 CFR 372

CAS NO	CHEMICAL NAME	% BY WGT
7727-43-7	BARIUM SULFATE (TOTAL DUST)	26.820
1344-28-1	ALUMINUM OXIDES	2.070
71-36-3	N-BUTANOL (SKIN)	8.650
100-41-4	ETHYL BENZENE	2.520
1330-20-7	XYLENE	10.590

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OSHA PEL - C 000 NO INFO AVAILABLE
 VAPOR FRESSURE 000 NOT APPLICABLE
 Not applicable

INGREDIENT POLYAMIDE RESIN
 PERCENT BY VOLUME PROPRIETARY
 OCCUPATIONAL EXPOSURE LIMITS

CAS#

ACGIH TLV - TWA 000 NO INFO AVAILABLE
 ACGIH TLV - STEL 000 NO INFO AVAILABLE
 ACGIH TLV - C 000 NO INFO AVAILABLE
 OSHA PEL - TWA 000 NO INFO AVAILABLE
 OSHA PEL - STEL 000 NO INFO AVAILABLE
 OSHA PEL - C 000 NO INFO AVAILABLE
 VAPOR FRESSURE 000 NO INFO AVAILABLE

The information contained in this section is considered confidential and proprietary and should be used only for safety and health purposes

INGREDIENT N BUTANOL (SKIN)
 PERCENT BY VOLUME 18.620%

CAS# 71-36-3

OCCUPATIONAL EXPOSURE LIMITS
 ACGIH TLV - TWA 000 NO INFO AVAILABLE
 ACGIH TLV - STEL 000 NO INFO AVAILABLE
 ACGIH TLV - C 50 000 PPM
 OSHA PEL - TWA 100 000 PPM
 OSHA PEL - STEL 000 NO INFO AVAILABLE
 OSHA PEL - C 50 000 PPM

VAPOR FRESSURE 4 400 MMHG AT 20C

INGREDIENT TRIETHYLENE TETRAMINE
 PERCENT BY VOLUME 1.480%

CAS# 112-24-3

OCCUPATIONAL EXPOSURE LIMITS
 ACGIH TLV - TWA 000 NO INFO AVAILABLE
 ACGIH TLV - STEL 000 NO INFO AVAILABLE
 ACGIH TLV - C 000 NO INFO AVAILABLE
 OSHA PEL - TWA 000 NO INFO AVAILABLE
 OSHA PEL - STEL 000 NO INFO AVAILABLE
 OSHA PEL - C 000 NO INFO AVAILABLE

VAPOR FRESSURE Not applicable

INGREDIENT ETHYL BENZENE
 PERCENT BY VOLUME 5.040%

CAS# 100-41-4

OCCUPATIONAL EXPOSURE LIMITS
 ACGIH TLV - TWA 100 000 PPM
 ACGIH TLV - STEL 125 000 PPM
 ACGIH TLV - C 000 NO INFO AVAILABLE
 OSHA PEL - TWA 100 000 PPM
 OSHA PEL - STEL 125 000 PPM
 OSHA PEL - C 000 NO INFO AVAILABLE

VAPOR FRESSURE 6 000 MMHG AT 20C

INGREDIENT XYLENE
 PERCENT BY VOLUME 21.180%

CAS# 1330-20-7

OCCUPATIONAL EXPOSURE LIMITS
 ACGIH TLV - TWA 100 000 PPM
 ACGIH TLV - STEL 150 000 PPM
 ACGIH TLV - C 000 NO INFO AVAILABLE
 OSHA PEL - TWA 100 000 PPM
 OSHA PEL - STEL 150 000 PPM
 OSHA PEL - C 000 NO INFO AVAILABLE

VAPOR FRESSURE 5 100 MMHG AT 20C

The information contained in this section is considered confidential and proprietary and should be used only for safety and health purposes

SECTION 03 - HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE ACUTE (SHORT TERM)

INHALATION OVEREXPOSURE TO SOLVENT VAPORS OR SPRAY MIST MAY CAUSE nasal and respiratory irritation, anesthetic effects, dizziness, possible unconsciousness and asphyxiation, stupor, weakness, fatigue, nausea, and headache

INHALATION OVEREXPOSURE TO FREE PIGMENT DUST MAY CAUSE Coughing, wheezing, shortness of breath, restricted nasal passages.

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MATERIAL SAFETY DATA SHEET

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lung injury.

INHALATION OTHER

Not applicable

SKIN - PROLONGED OR REPEATED CONTACT MAY CAUSE

Moderate irritation, drying of skin, defatting and possible dermatitis

EYES - CONTACT MAY RESULT IN

Redness, tearing, blurred vision.

May result in permanent visual loss

Severe irritation

INGESTION MAY RESULT IN

Gastrointestinal irritation, nausea, vomiting, diarrhea, death,

aspiration into the lungs which can be fatal

CHRONIC (LONG TERM, CUMULATIVE)

NOTICE Reports have associated repeated and prolonged occupational

overexposure to solvents with permanent brain and nervous system

damage. Intentional misuse by deliberately concentrating and

inhaling the vapors may be harmful or fatal.

Prolonged or repeated contact with skin may cause primary

irritation, dermatitis, or allergic skin reactions.

TARGET ORGAN EFFECTS

ANIMAL AND/OR HUMAN STUDIES OF CERTAIN CHEMICALS IN THIS PRODUCT HAVE

SHOWN THE FOLLOWING TARGET ORGAN EFFECTS

Can cause liver damage

Can cause kidney damage

Can cause lung damage

Can cause nervous system effects

Can cause skin sensitization

Can cause eye irritation.

Can cause skin irritation

Can cause respiratory tract irritation.

Can cause gastrointestinal tract irritation

TOXICITY INFORMATION

Consult various toxicology references such as NIOSH's "Registry of Toxic Effects of Chemical Substances" or Sax's "Dangerous Properties of Industrial Chemicals" for specific toxicity information

regarding hazardous ingredients

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY OVEREXPOSURE

Not applicable

PRIMARY ROUTES OF ENTRY

Dermal and Inhalation

EMERGENCY AND FIRST AID PROCEDURES

INHALATION

Remove affected individual to fresh air. Treat symptomatically. If breathing is difficult, administer oxygen. If breathing has stopped give artificial respiration. Consult a physician

SKIN CONTACT

Wash affected area with soap and water. Remove contaminated clothing. Dispose of or launder accordingly. Consult a physician if skin irritation persists

EYE SPLASH

Flush immediately with large amounts of clean water under low pressure for at least 15 minutes. Consult a physician

INGESTION

Drink 1 or 2 glasses of water to dilute. Do not induce vomiting. Consult physician or poison control center IMMEDIATELY. Treat symptomatically

PROPOSITION 65

Pigments and/or other raw materials present in this product contain trace amounts of a chemical or chemicals known to the State of California to cause cancer, birth defects or other reproductive harm

OTHER

This product when mixed with other components acquires the hazards of all components

SECTION 04 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (F) (SETA FLASH CLOSED CUP)

082

LOWER EXPLOSIVE LIMIT (LEL)

1.00

FLAMMABILITY CLASSIFICATION

OSHA

Flammable liquid - Class IC

DOT

Flammable liquid

EXTINGUISHING MEDIA

Foam, carbon dioxide, and dry chemical

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep away from heat, open flames, sparks, and areas where static charge may be generated. Do not apply to hot surfaces due to



S-20

201
202 } Coating
203
204

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MATERIAL SAFETY DATA SHEET PAGE 1 OF 5

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FOR COATINGS, RESINS, AND RELATED MATERIALS
(APPROVED BY THE U.S. DEPARTMENT OF LABOR AS
'ESSENTIALLY SIMILAR' TO FORM OSHA-20)
(MEETS REQUIREMENTS OF CFR 29 PART 1910.1200,
CSPA'S HAZARD COMMUNICATION STANDARDS)

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N231 SECTION 01 - MANUFACTURER AND PRODUCT INFORMATION

MANUFACTURER

TNE MEC COMPANY, INC
123 WEST 23RD AVENUE
NORTH KANSAS CITY, MO
64116-3064

DATE PRINTED

09/09/92

CURRENT FORMULA DATE 03/12/90

EMERGENCY TELEPHONE NO. 816-474-1425
INFORMATION TELEPHONE NO. 816-474-3400

PREVIOUS FORMULA DATE 12/15/89

TRADE NAME SERIES 020 POTA-POX

MANUFACTURER'S CODE IDENTIFICATION F020-AA90A COLOR WHITE

PRODUCT CLASS POLYAMIDE

SECTION 02 - HAZARDOUS INGREDIENTS

INGREDIENT TITANIUM DIOXIDE (TOTAL DUST)

PERCENT BY WEIGHT PROPRIETARY

CAS# 13463-67-7

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	10.000	MG/M3
ACGIH TLV - STEL	.000	NO INFO AVAILABLE
ACGIH TLV - C	.000	NO INFO AVAILABLE
OSHA PEL - TWA	10.000	MG/M3
OSHA PEL - STEL	.000	NO INFO AVAILABLE
OSHA PEL - C	.000	NO INFO AVAILABLE
VAPOR PRESSURE	.000	NOT APPLICABLE

Not applicable

INGREDIENT TALC (NO ASBESTOS FIBERS/RESPIRABLE DUST)

PERCENT BY WEIGHT PROPRIETARY

CAS# 14807-96-6

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	2.000	MG/M3
ACGIH TLV - STEL	.000	NO INFO AVAILABLE
ACGIH TLV - C	.000	NO INFO AVAILABLE
OSHA PEL - TWA	2.000	MG/M3
OSHA PEL - STEL	.000	NO INFO AVAILABLE
OSHA PEL - C	.000	NO INFO AVAILABLE
VAPOR PRESSURE	.000	NOT APPLICABLE

Not applicable

INGREDIENT AMORPHOUS SILICA (DIATOM EARTH/UNCALCINED/TOTAL DUST)

PERCENT BY WEIGHT PROPRIETARY

CAS# 7631-86-9

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	10.000	MG/M3
ACGIH TLV - STEL	.000	NO INFO AVAILABLE
ACGIH TLV - C	.000	NO INFO AVAILABLE
OSHA PEL - TWA	6.000	MG/M3
OSHA PEL - STEL	.000	NO INFO AVAILABLE
OSHA PEL - C	.000	NO INFO AVAILABLE
VAPOR PRESSURE	.000	NOT APPLICABLE

Not applicable

INGREDIENT BARIUM SULFATE (TOTAL DUST)

PERCENT BY WEIGHT PROPRIETARY

CAS# 7727-43-7

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	10.000	MG/M3
ACGIH TLV - STEL	.000	NO INFO AVAILABLE
ACGIH TLV - C	.000	NO INFO AVAILABLE
OSHA PEL - TWA	10.000	MG/M3
OSHA PEL - STEL	.000	NO INFO AVAILABLE
OSHA PEL - C	.000	NO INFO AVAILABLE
VAPOR PRESSURE	.000	NOT APPLICABLE

Not applicable

ACCIH TLV - STEL
ACCIH TLV - C
CSHA PEL - TWA
OSHA PEL - STEL
OSHA PEL - C
VAPOR PRESSURE
Not applicable

INGREDIENT ALUMINUM OXIDES
PERCENT BY WEIGHT 2.0702
OCCUPATIONAL EXPOSURE LIMITS
ACCIH TLV - TWA
ACCIH TLV - STEL
ACCIH TLV - C
OSHA PEL - TWA
OSHA PEL - STEL

000 NO INFO AVAILABLE
000 MG/M3
10.000 NO INFO AVAILABLE
000 NO INFO AVAILABLE
000 NO INFO AVAILABLE
000 NOT APPLICABLE

CASH 1344-28-1

10 000 MG/M3
0.000 NO INFO AVAILABLE
0.000 NO INFO AVAILABLE
0.000 NO INFO AVAILABLE
0.000 NO INFO AVAILABLE

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DOT

Flammable liquid
EXTINGUISHING MEDIA

Foam, carbon dioxide, and dry chemical.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Keep away from heat, open flames, sparks, and areas where static charge may be generated. Do not apply to hot surfaces due to possible fire and explosion risk. For closed containers, pressure build-up and possible explosion might occur due to extreme heat exposure. Solvent vapors are heavier than air and may travel considerable distance to a source of ignition and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES

Water may be used to cool unruptured containers. Wear self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode to prevent inhalation of hazardous decomposition products. Use appropriate extinguishing media to control fire. Water may cause violent frothing if sprayed directly into containers of burning liquid.

SECTION 05 - REACTIVITY DATA

STABILITY

Stable
INCOMPATIBILITY (MATERIALS TO AVOID)

Strong oxidizing agents

Bases

Acids.

Amires

CONDITIONS TO AVOID

Heat, sparks, open flames

Amire compounds under uncontrolled conditions

Isocyanate compounds under uncontrolled conditions

HAZARDOUS DECOMPOSITION PRODUCTS - FIRE, BURNING OR MELTING OF COATING PRODUCTS MAY FORM

Carbon monoxide, carbon dioxide, hydrocarbon fragments

HAZARDOUS POLYMERIZATION

Will not occur.

SECTION 06 - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Remove all sources of ignition. Spills may be collected with inert, absorbent material for proper disposal. Use non-sparking tools, protective gloves, goggles and clothing, adequate ventilation, avoid the breathing of vapors and use respiratory protective device. Transfer absorbent material to suitable containers for proper disposal.

WASTE DISPOSAL METHOD

Dispose of in accordance with Federal, state, and local regulations regarding pollution.

SECTION 07 - SAFE HANDLING AND USE INFORMATION

RESPIRATORY PROTECTION

Respiratory protective devices must be used when engineering and administration controls are not adequate to maintain Threshold Limit Values (TLV) and Permissible Exposure Limits (PEL) of airborne contaminants below the listed values for those hazardous ingredients identified in Section II of this MSDS. Observe OSHA regulations for respirator use (CFR 29, 1910.134) whenever a respirator is used. Particulate, chemical cartridge, air purifying half-mask respirators can be used within certain limitations; consult the respirator manufacturer for specific uses and limitations. Where airborne contaminant concentrations are unknown, the use of a NIOSH/MSHA approved fresh-air supplied respirator is mandatory.

VENTILATION

Sufficient ventilation, in volume and pattern, should be provided through both local and general exhaust to keep the air contaminant concentration below current applicable OSHA Permissible Exposure Limits (PEL) and ACGIH's Threshold Limit Values (TLV). Appropriate ventilation should be employed to remove hazardous decomposition products formed during welding or flame cutting operations of surfaces coated with this product.

Heavier than air solvent vapors should be removed from lower levels of work area due to potential explosion hazard and all ignition sources (non-explosion proof equipment) should be eliminated if

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flammable mixtures will be encountered
PROTECTIVE GLOVES
Chemical resistant
EYE PROTECTION
Use chemical resistant splash type goggles
OTHER PROTECTIVE EQUIPMENT
Use chemical resistant coveralls or apron to protect against skin
and clothing contamination
HYGENIC PRACTICES
Wash hands and other contaminated skin areas with warm soap and
water before eating

SECTION 08 - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE
Store in dry area Keep closures tight and upright to prevent
leakage Do not store in high temperature areas or near fire or
open flame Refer to product data sheet for recommended storage
temperatures
OTHER PRECAUTIONS
Do not use near heat, sparks, or open flame Use approved grounding
procedures Prevent prolonged breathing of vapor or spray mist
Prevent contact with skin and eyes. Do not take internally. Keep
out of reach of children Do not reuse or alter containers without
proper industrial cleaning Do not weld or flame cut empty,
uncleaned containers due to potential fire and explosion hazard.
Consult product data sheet for proper application instructions.

SECTION 09 - PHYSICAL DATA

BOILING RANGE (F AT 760 MMHG) 237 - 288
VAPOR DENSITY HEAVIER THAN AIR
WEIGHT PER GALLON 10.68
% VOLATILE BY VOLUME 42.400
% SOLIDS BY WEIGHT 72.502
EVAPORATION RATE SLOWER - ETHYL ETHER
VOC (LBS/GAL) 2.925

SECTION 10 - OTHER INFORMATION

For specific information regarding occupational safety and health
standards, please refer to the Code of Federal Regulations, Title
29, Part 1-10

To the best of our knowledge, the information contained herein is
accurate. However, neither the Inemec Company or any of its
subsidiaries assume any liability whatsoever for the accuracy or
completeness of the information contained herein. Final
determination of suitability of any material is the sole
responsibility of the user. All materials may present unknown
health hazards and should be used with caution. Although certain
hazards are described herein, we cannot guarantee that these are the
only hazards which exist

SECTION 11 - RIGHT-TO-KNOW INFORMATION

THIS PRODUCT CONTAINS THE FOLLOWING TOXIC CHEMICALS SUBJECT TO THE
REPORTING REQUIREMENTS OF SECTION 313 OF THE EMERGENCY PLANNING &
COMMUNITY RIGHT TO-KNOW ACT OF 1986 AND OF 40 CFR 372

CAS NO	CHEMICAL NAME	% BY WT
1330-20-7	XYLENE	10.780
108-10-1	METHYL ISOBUTYL KETONE	16.300
	aka isopropyl acetone	
	aka 4 methyl 2-pentanone	

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201 } COATING
202 }
203 }
204 }

FOR COATINGS, RESINS, AND RELATED MATERIALS
(APPROVED BY THE U.S. DEPARTMENT OF LABOR AS
'ESSENTIALLY SIMILAR' TO FORM OSHA-20)
(MEETS REQUIREMENTS OF CFR 29 PART 1910 1200,
(SHA S HAZARD COMMUNICATION STANDARD)

NPCA 1-84

N231 SECTION 01 - MANUFACTURER AND PRODUCT INFORMATION

MANUFACTURER

TNEMEC COMPANY, INC
123 WEST 23RD AVENUE
NORTH KANSAS CITY, MO.
64116-3064

DATE PRINTED 09/09/92

CURRENT FORMULA DATE 12/06/90

EMERGENCY TELEPHONE NO 816-474-1425
INFORMATION TELEPHONE NO 816-474-3400

PREVIOUS FORMULA DATE 04/23/90

TRADE NAME SERIES 020 POTA-POX

MANUFACTURER'S CODE IDENTIFICATION F020-0020E COLOR CONVERTER

PRODUCT CLASS EPOXY

SECTION 02 - HAZARDOUS INGREDIENTS

INGREDIENT TALC (NO ASBESTOS FIBERS/RESPIRABLE DUST)

PERCENT BY WEIGHT PROPRIETARY

CAS# 14807-96-6

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	2 000	MG/M3
ACGIH TLV - STEL	000	NO INFO AVAILABLE
ACGIH TLV - C	000	NO INFO AVAILABLE
OSHA PEL - TWA	2 000	MG/M3
OSHA PEL - STEL	000	NO INFO AVAILABLE
OSHA PEL - C	000	NO INFO AVAILABLE
	000	NOT APPLICABLE

VAPOR PRESSURE
Not applicable

INGREDIENT BISPHENOL A TYPE EPOXY RESIN

PERCENT BY WEIGHT PROPRIETARY

CAS#

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	000	NOT APPLICABLE
ACGIH TLV - STEL	000	NOT APPLICABLE
ACGIH TLV - C	000	NOT APPLICABLE
OSHA PEL - TWA	000	NOT APPLICABLE
OSHA PEL - STEL	000	NO INFO AVAILABLE
OSHA PEL - C	000	NOT APPLICABLE
	000	NOT APPLICABLE

VAPOR PRESSURE
Not applicable

INGREDIENT XYLENE

PERCENT BY VOLUME 16 070X

CAS# 1330-20-7

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	100 000	PPM
ACGIH TLV - STEL	150 000	PPM
ACGIH TLV - C	000	NO INFO AVAILABLE
OSHA PEL - TWA	100 000	PPM
OSHA PEL - STEL	150 000	PPM
OSHA PEL - C	000	NO INFO AVAILABLE
	5 100	MMHG AT 20C

VAPOR PRESSURE

INGREDIENT METHYL ISOBUTYL KETONE

PERCENT BY VOLUME 26 100X

CAS# 108-10-1

OCCUPATIONAL EXPOSURE LIMITS

ACGIH TLV - TWA	50 000	PPM
ACGIH TLV - STEL	75 000	PPM
ACGIH TLV - C	000	NO INFO AVAILABLE
OSHA PEL - TWA	50 000	PPM
OSHA PEL - STEL	75 000	PPM
OSHA PEL - C	000	NO INFO AVAILABLE
	16 000	MMHG AT 20C

VAPOR PRESSURE

The information contained in this section is considered confidential and proprietary and should be used only for safety and health purposes

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SECTION 03 - HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE

ACUTE (SHORT TERM)

INHALATION OVEREXPOSURE TO SOLVENT VAPORS OR SPRAY MIST MAY CAUSE Nasal and respiratory irritation, anesthetic effects, dizziness, possible unconsciousness and asphyxiation, stupor, weakness, fatigue, nausea, and headache.

INHALATION OVEREXPOSURE TO FREE PIGMENT DUST MAY CAUSE Coughing, wheezing, shortness of breath, restricted nasal passages, lung injury.

INHALATION OTHER

Not applicable

SKIN - PROLONGED OR REPEATED CONTACT MAY CAUSE

Moderate irritation, drying of skin, defatting and possible dermatitis

EYES CONTACT MAY RESULT IN

Redness, tearing, blurred vision

Severe irritation

INGESTION MAY RESULT IN

Gastrointestinal irritation, nausea, vomiting, diarrhea, death, aspiration into the lungs which can be fatal

CHRONIC (LONG TERM, CUMULATIVE)

NOTICE Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the vapors may be harmful or fatal

TARGET ORGAN EFFECTS

ANIMAL AND/OR HUMAN STUDIES OF CERTAIN CHEMICALS IN THIS PRODUCT HAVE SHOWN THE FOLLOWING TARGET ORGAN EFFECTS

- Can cause liver damage
- Can cause kidney damage
- Can cause lung damage
- Can cause nervous system effects.
- Can cause eye irritation.
- Can cause skin irritation
- Can cause respiratory tract irritation
- Can cause gastrointestinal tract irritation

TOXICITY INFORMATION

Consult various toxicology references such as NIOSH's "Registry of Toxic Effects of Chemical Substances" or Sax's "Dangerous Properties of Industrial Chemicals" for specific toxicity information regarding hazardous ingredients

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY OVEREXPOSURE

Not applicable

PRIMARY ROUTES OF ENTRY

Dermal and Inhalation

EMERGENCY AND FIRST AID PROCEDURES

INHALATION

Remove affected individual to fresh air. Treat symptomatically. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Consult a physician.

SKIN CONTACT

Wash affected area with soap and water. Remove contaminated clothing. Dispose of or launder accordingly. Consult a physician if skin irritation persists.

EYE SPLASH

Flush immediately with large amounts of clean water under low pressure for at least 15 minutes. Consult a physician.

INGESTION

Drink 1 or 2 glasses of water to dilute. Do not induce vomiting. Consult a physician or poison control center IMMEDIATELY. Treat symptomatically.

PROPOSITION 65

This product contains a chemical or chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

OTHER

This product when mixed with other components acquires the hazards of all components.

SECTION 04 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (F) (SETA FLASH CLOSED CUP) 064

LOWER EXPLOSIVE LIMIT (LEL) 1.00

FLAMMABILITY CLASSIFICATION

OSHA

Flammable liquid - Class IB

